(Established 1832.)

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CONTENTS.

PRODUCTION IMPROVEMENTS.

Chicago Shops—C. & N. W. Railway.

A repair shop which has turned out 50 locomotives with general repairs from 21 pits in one month is entitled to high rank, not only among railroads, but commercial establishments. These shops have done this and they are turning out regularly upwards of 40 locomotives per month. This is an old shop, built over 30 years ago and without crane service except in the boiler shop. (American Engineer, April, 1900, page 111). These shops constitute an admirable example of improvement, showing the possibilities of a definite policy of renewing machine equipment in an old plant, partially rebuilt 4 years ago, and operated throughout on a day rate basis.

In February, 1904 (page 58), this journal illustrated the shop schedule for repairs which has been the means of reducing delays incidental to waiting for material. The first schedule was put into effect in November, 1902, and it classified repairs as follows: Class 1. General repairs, including fireboxes (half side sheets and a flue sheet being equivalent to a firebox). This required 240 hours. Class 2. General repairs with half-side sheets, 210 hours. Class 3. General repairs, including a back flue sheet, 160 hours. Class 4. Heavy repairs, without new firebox sheets, 120 hours. Since its inauguration the schedule has been reduced as follows: Class 1 to 220 hours; Class 2 to 170 hours; Class 3 to 130 hours, and Class 4 to 100 hours. Therefore at the present time the average time of a locomotive in the shop for all classes of heavy repairs is 15.5 days.

One factor in this improvement is the meeting of all the shop foremen, which is called at 10.30 every Monday morning. Statements of the condition of work in the shop (see form, American Engineer, February, 1904, page 58) are ready for this meeting and each locomotive is discussed in detail, and delays and expected delays are brought to light and provided for. In this way the work on one engine may be advanced to take the place of other work which is delayed. None of the foremen like to see their work on the delayed list and they look forward in every possible way to insure having material and parts ready when wanted. In the month of January, 1905, one foreman having 5 pits turned out 9 engines, another with 4 pits turned out the same number. Two of the other 3 foremen with 4 pits each turned out 8 and the fifth turned out 7 engines.

In order to keep the men out of each other's way, a night gang of 2 boiler makers and 2 helpers is used to hasten delayed work. Two other men work at night on ash pans and front ends. These men can work without interference with the other gangs because they have the engines to themselves. All stripping is done under the big crane in the boiler shop and the work is distributed from there. The lye vats are located between the boiler and erecting shops and the work halts on its way across. In case a locomotive is delayed when nearly finished it is moved out of the shop and waits in the boiler shop, or out of doors instead of occupying more valuable space in one of the shop pits.

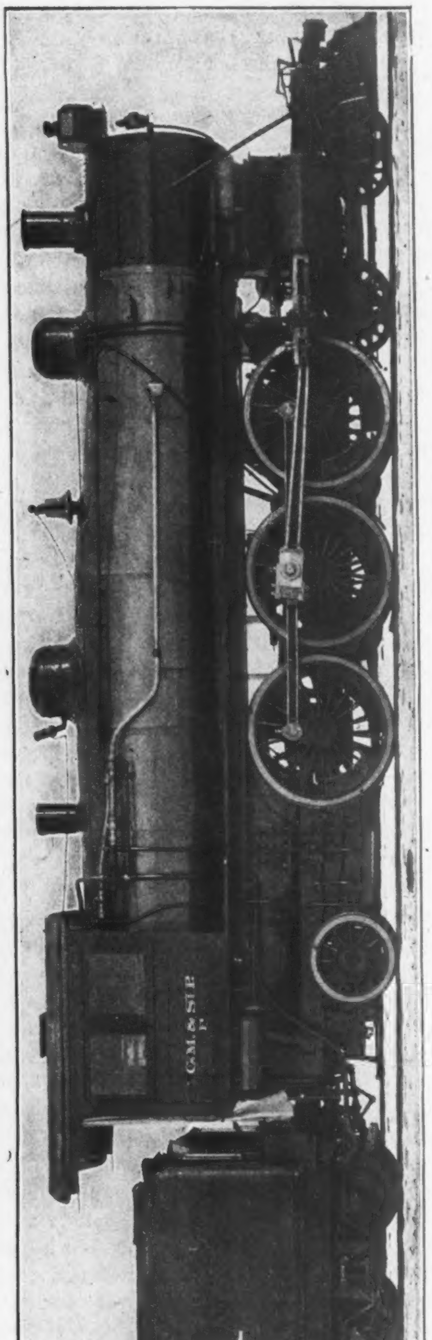
These shops were extended early in 1900 and additional facilities were provided, which have been described in this journal (reference already given). Since then the machine tool equipment has been continually improved, and this work is going on steadily. Whenever a new machine is available which will increase the output after the old machinery has been brought up to its limit the old gives place to the new. This method develops the old equipment and puts the organization in position to secure the full advantages of improvements. About two years ago the line shafting was speeded up from 120 to 150 r.p.m. by changing the motor pulleys, the motors being of sufficient capacity to render this possible. Six months ago it was again speeded up to 200 revolutions.

The wheel lathes supply an excellent example of the shop output. A Niles lathe of light construction, about 4 years old, has received special attention and by using improved tool steel and better appliances for handling wheels, together with better methods of driving the wheels in the lathe, a considerable increase in output has been secured. For instance, the driving dogs are placed near the rim of the wheel and the chattering is reduced. The slides have been cut away next to the face plates so that the driving dogs will clear and adjustable dogs are used, permitting the bearings of all to be made alike. This is important in working on large driving wheels.

This work is done at slow cutting speeds of from 12 to 14 ft. per minute. Heavy feeds are used and but one cut is taken over a tire, with a feed varying from 1/8 to 3-16 in. according to the condition of the tire as to wear. Tires are left rough on the tread without a finishing cut. It has been found possible to remove more material by the slow speed and heavy feed than by high speed and light feed. Only the best tool steels are used. Formerly a gauge was employed to get the correct height of the flange. Now the tool post screw is turned a certain number of times. By knowing the pitch of the screw the standard height of flange is secured without measuring. Every minute counts on this work. The operator changes the position of the tool as little as possible and he uses the same tool for facing the tread and roughing both sides of the flange, this being a right and left hand roughing tool. A forming tool finishes the flange on both sides at once. One and a quarter in. square tool steel is used for the tools and these are held in holders.

An average result for 20 days' work was 3.4 pairs of drivers in 9 hours, with wheels varying from 52 to 74 ins. in diameter. About the same time is required for small as for large wheels, as the small ones are usually badly worn. Before these improvements were introduced 4½ hours per pair was considered good work.

Among the factors contributing to the high standing of this plant is a cost keeping system, whereby the actual cost of each portion of the work is kept and the records are very carefully watched. It is very apparent in going through this shop that a great deal of lost motion has been eliminated. It is crowded and with a very old building work is turned out, because of organization and methods, which is not at the present time matched in any of the larger and more modern shops which the writer has visited. This is very creditable to Mr. Quayle, superintendent of motive power; Mr. H. T. Bentley, assistant superintendent of motive power, and Mr. Otto, general foreman.



PASSENGER LOCOMOTIVE 4—6—2 TYPE.—CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

Designed by A. E. MANCHESTER, *Superintendent Motive Power.* *Built by* C., M. & ST. P. RY.

J. F. DEVOY, *Mechanical Engineer.*

SIX-COUPLED PASSENGER LOCOMOTIVES.

4—6—2 TYPE—CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

The policy of the Chicago, Milwaukee & St. Paul Railway is to design and build all of its locomotives. Mr. A. E. Manchester, superintendent of motive power, has put into service a new Pacific type engine with a number of features which differ in a marked way from current practice, this design having been worked out under his direction by Mr. J. F. De Voy, mechanical engineer of the road. The "Pioneer Limited," which this engine is now hauling, frequently consists of 16 cars, which has proved to be too heavy a load for any engine previously put into service on this road. The new trailing truck, the narrow firebox and short flues are special features of this design, the narrow firebox being one of the points to which Mr. Manchester holds as being correct. After being in service for a month, the steaming qualities are said to be entirely satisfactory. While the length of the firebox is 10 ft. 6 ins., the slope of the back head is such as to necessitate throwing the coal less than 10 ft. to the front end of the grate. The firedoor also is high. This design necessitates an extremely long smokebox, the distance from the front tube sheet to the forward edge of the smokebox ring being 7 ft. 3 ins. A maximum length of 16 ft. 6 ins. was fixed for the flues, and the diameter was fixed at 2 ins. In arranging the equalizer system a bar was carried across the engine in front of the ash pan, to which the longitudinal trailing truck equalizers connect. In the trailing truck a lateral movement of 5 ins. is provided, and this without a radius bar or anything which will give a radial movement. This truck consists of a very simple construction of two boxes placed between jaws, the centering effect being obtained by the use of rollers. Not counting the rollers, the truck is in four parts. This construction will be referred to again in detail. The chief feature of interest is the fact that the engine was designed throughout and built by the road, this being the only railroad in the country which has adopted this policy, which was not at all uncommon years ago. If the narrow firebox and long smokebox prove satisfactory in service, current practice will be shown to be wrong. The chief dimensions are presented in the following table, which also includes the tractive effort and adhesive ratio:

PASSENGER LOCOMOTIVES, C. M. & ST. PAUL RY., 4-6-2 TYPE.

Gauge of track	4 ft. 8½ ins.
Cylinders	23 ins. by 26 ins.
Driving wheels, diameter	72 ins.
Weight on driving wheels	142,000 lbs.
Weight of engine, total	218,000 lbs.
Weight of tender loaded	125,600 lbs.
Weight of engine and tender	343,600 lbs.
Wheel base of engine	32 ft. 5 ins.
Driving wheel base	17 ft. 1 in.
Wheel base of engine and tender	60 ft.
Boiler pressure	200 lbs.
Boiler plates, steel, thickness	¾ in.
Firebox plates, thickness	½ in., ⅝ in. and 5-16 in.
Firebox, length and width	41⅛ in. by 126 in.
Firebox, depth	70½ in. and 84 in.
Staying	radial
Flues, number	363
Flues, length	16 ft. 6 ins.
Flues, diameter	2 ins.
Heating surface, flues	3,136 sq. ft.
Heating surface, firebox	245.6 sq. ft.
Heating surface, total	3,381.6 sq. ft.
Grate area	35.8 sq. ft.
Boiler, diameter first ring	72 ins.
Center of boiler above rail	113 ins.
Steam ports	1⅝ ins.
Exhaust ports	2½ ins.
Bridges	1⅞ ins.
Eccentric throw	6 ins.
Valve travel	6 ins.
Steam lap	1 in.
Exhaust lap (negative)	⅛ in.
Driving journals	9 ins. by 12 ins.
Crank pin journals, front	5 ins. by 4½ ins.
Crank pin journals, main	6½ ins. by 7 ins. and 7½ ins. by 4¾ ins.
Engine truck wheels	33 ins.
Trailing wheels	42 ins.
Tender coal capacity	**10 tons**
Tender water capacity	**7,000 gallons**
Tractive effort	**32,500 lbs.**
Ratio of adhesion	**4.36**

ANGUS LOCOMOTIVE AND CAR SHOPS, MONTREAL

CANADIAN PACIFIC RAILWAY.

IV.

(*For previous article, see page 37.*)

POWER PLANT.—The power plant is in a 100 by 160 ft. building, divided into a boiler and an engine room by a longitudinal wall. The boiler room has seven Babcock & Wilcox boilers of 416 h.p. each, at 150 lbs. pressure and one 300 h.p. of the same make, with a pressure of 300 lbs., intended for use in testing locomotives and provided with reducing valves for use with the other boilers. Four boilers have Neemes' shaking grates arranged for hand firing and also to receive shavings from an extensive shavings exhaust system from the planing mill and cabinet shop. Three boilers have Babcock & Wilcox chain grate stokers. Induced draft is furnished by two 10-ft. Sturtevant fans, used in connection with an 8-ft. steel stack 70 ft. high. The fans run at about 200 r.p.m., and work in connection with two Green economizers, which are connected to all of the eight boilers. The boilers connect to a 12-in. boiler room header. Feed water is supplied by two 12 by 7 by 12 in. Northey feed pumps and two 6 by 3½ by 6 in. feed pumps are provided specially for the high pressure boiler. Coal is discharged in front of the boilers from a trestle outside of the building. Ashes pass into the hoppers at the floor, from which they are emptied into cars on a track in the tunnel under the boiler room floor, reaching an air hoist outside of the building for dumping the cars into freight cars on a service track. Tunnels run from the power house to the most important buildings, carrying the steam pipes, water pipes and drainage returns from the various buildings.

Along the boiler room wall, the full length of the engine room, is a large pit, which provides for all of the pumps and piping connected therewith, and this is depressed about 6 ft. 6 in. below the main engine room floor. It is spanned by gratings for passage ways over it. The main engines, three in number, are of 750 h.p.; in addition to these there is one 375 h.p. auxiliary. All of them run at 150 rev. per min. In the drawings and photographs of the power house the arrangement of piping is shown. This power plant was designed by Mr. Henry Godmark, Messrs. Ross & Holgate, acting as consulting engineers.

GENERATORS AND ENGINES.—Canadian General Electric Company's apparatus is installed throughout. Both alternating and direct current systems are used, the latter only for the cranes and a few individual tool drives. The alternating current is 3-phase, 60-cycle and 600-550 volts, the direct current being at 275-250 volts. Generating apparatus is installed as follows:

Three alternators of 500 k.w. nominal rating; voltage, full load 600; amperes, 480; rev. per min., 150 direct connected to Robb-Armstrong cross-compound non-condensing engines having 21 and 33 by 24 in. cylinders. One alternator of 250 k.w. nominal rating; voltage, full load 600; amperes, 240; rev. per min., 150, direct connected to a Robb-Armstrong non-condensing engine having 18 by 24 in. cylinders. Two D. C. generators giving 250 volts at no load and 275 volts at full load, amperes, 727; running at 180 rev. per min., each direct connected to a Robb-Armstrong non-condensing 18 by 20 in. engine. Two exciter sets giving 115 volts at no load and 125 at full load, amperes, 400; running at 230 rev. per min., each direct connected to a Robb-Armstrong 10 by 12 in. non-condensing engine.

SWITCHBOARD.—The board has 4 A. C. generator, 1 A. C. totaling, 10 A. C. feeder, one exciter and two D. C. generator panels. It has one panel for series-arc lamps and one spare panel for an additional A. C. generator. The generator and feeder circuits are all fully equipped with Thompson ammeters and wattmeters. The A. C. totaling and the generator panels have power factor indicators and a synchronizing indicator. All the A. C. panels have double throw oil switch circuit breakers with time relays, connecting to either the main or auxiliary sets of bus bars. Series-arc lamps are used only for yard lighting, the shop lamps being fed from the power circuits.

MOTORS.—The A. C. motors aggregating 4,495 rated h.p. are of the constant speed induction type, with the exception of three motors, aggregating 70 h.p. which have secondary resistance external to the motors. All are wound for 550 volts. They range in size from 3 to 100 h.p. The direct current motors, aggregating 821 h.p., working on a voltage of 250, are used on the cranes, with the exception of 100 h.p. for individual tool drives in the locomotive shop. These have a 2 to 1 speed variation by means of variable field resistance. The distribution of the motors is shown in the motor table. Induction motors are used almost exclusively for driving groups and individual machines, with the exception of the cranes. The high efficiency of these motors, their durability and relatively low cost from repairs, led to their selection in preference to other types for the requirements of nearly constant speed and fairly uniform load. They are not readily adaptable to variable speed as required for individual machine drives, and when they are given variable speed characteristics the speed depends too largely upon the load. Woodworking machinery and group driving of machine tools and individual driving of tools requiring constant speed and fairly constant load, constitute the A. C. motor field.

MOTOR DISTRIBUTION.

ALTERNATING CURRENT INDUCTION MOTORS.

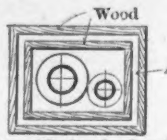
	Rated Horsepower of Motors.			
Shop.	Individual Drives.	Group Drives.	Fans and Blowers.	Total.
Planing mill	800	500	340	1,640
Cabinet	90	139	50	279
Power house	—	—	80	80
Truck	10	125	—	135
Car, machine and freight	55	190	—	245
Blacksmith	297	—	405	702
Grey iron foundry	3	23	50	76
Upholstery	—	10	—	10
Passenger car	—	10	—	10
Frog and switch	148	40	42	230
Boiler	118	27	40	185
Locomotive machine	220	574	—	794
Pattern	—	20	—	20
Wheel foundry	—	—	65	65
Transfer table	20	—	—	20
Totals	1,761 H.P.	1,658 H.P.	1,072 H.P.	4,491 H.P.
Percentage of total	39.2	37.0	23.8	100

DIRECT CURRENT MOTORS.

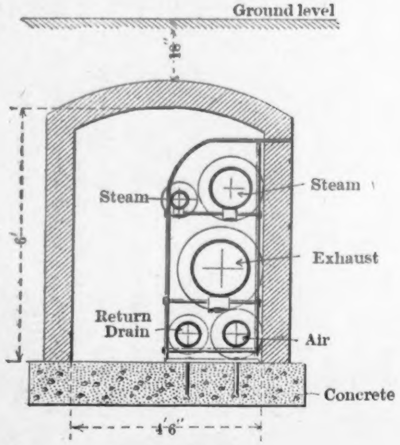
Shop.	Individual Drives.	Cranes.	Totals.
Midway crane	—	110	110
Wheel foundry	—	33	33
Locomotive machine	100	—	100
Locomotive shop	—	503	503
Grey iron foundry	—	65	65
Frog shop	—	10	10
Totals	100 H.P.	721 H.P.	821 H.P.

SHAVINGS EXHAUST.—This plant has the most extensive system of collecting and conveying shavings ever put into railroad shops. At the power house is a storage vault sufficient for a day's product from the mill and cabinet shop. Shavings are delivered direct from these buildings to the boilers or they may be sent down into the vault for storage. When working at its full capacity, building 30 cars per day, shavings enough will be produced to take the place of 18 tons of coal in the power house. Shavings are raised from the vault and delivered to the boilers by means of the blowers on top of the vault and through conduit connections, not shown in the engravings. This system will be referred to again in connection with the planing mill. At this plant the use of shavings was sufficiently important to influence the location of the power house. This is Sturtevant apparatus installed by C. H. Gifford & Company, managers of the Philadelphia house.

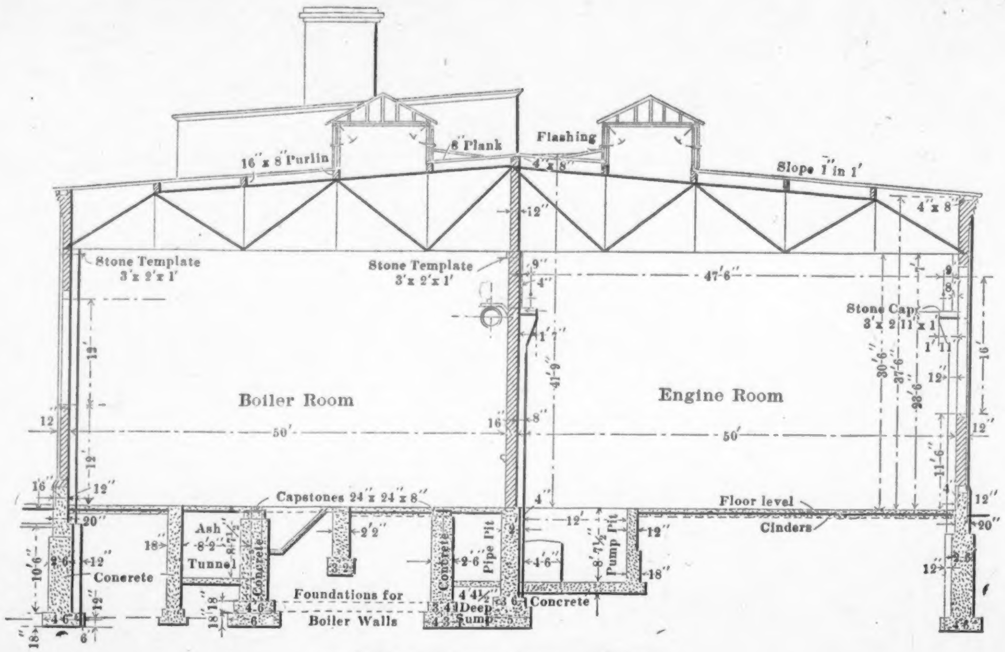
AIR COMPRESSOR.—Two machines by the Allis-Chalmers-Bullock Company have 20 by 24 in. high pressure steam, 32 by 24 in. low-pressure steam and 18¼ by 24 and 30¼ by 24 in. air cylinders. The valves are of the Meyer cut-off type, speed 65 to 100 rev. per min., with intercooler between the air cylinders. These have a capacity of 2,000 cu. ft. of free air per minute each.



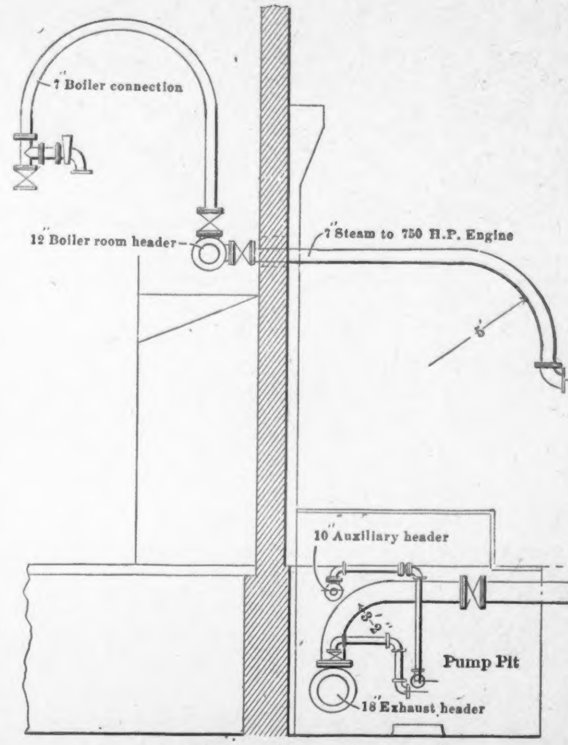
Section of Casing for Overhead and Underground Piping



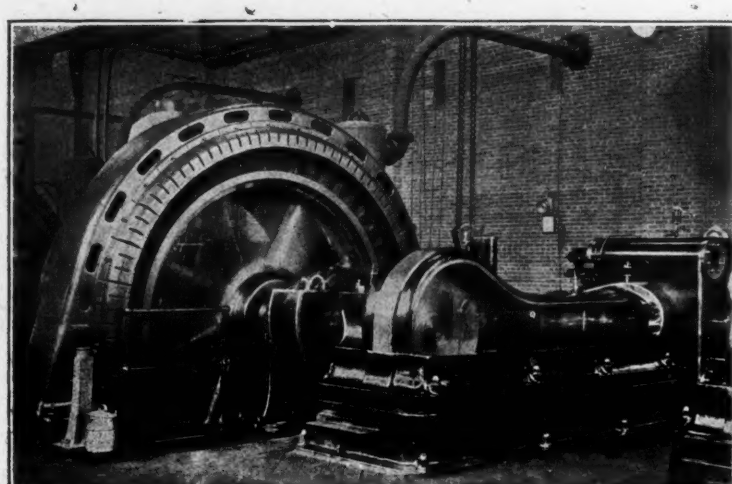
PIPE TUNNEL.



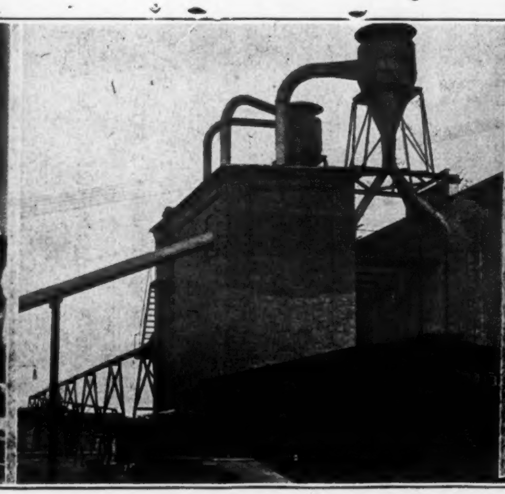
SECTION THROUGH POWER HOUSE.



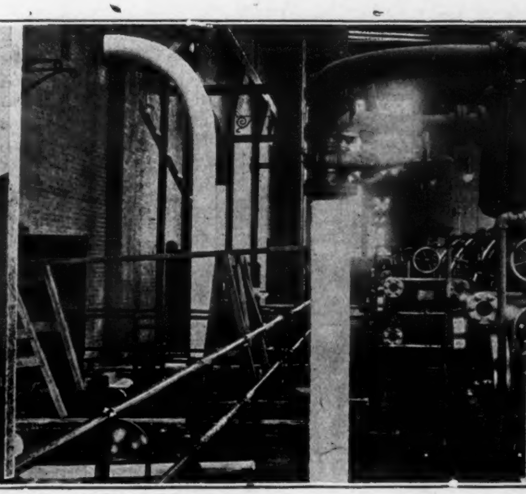
ARRANGEMENT OF PIPING.



ONE OF THE LARGE UNITS.



DUST COLLECTOR AND STORAGE.



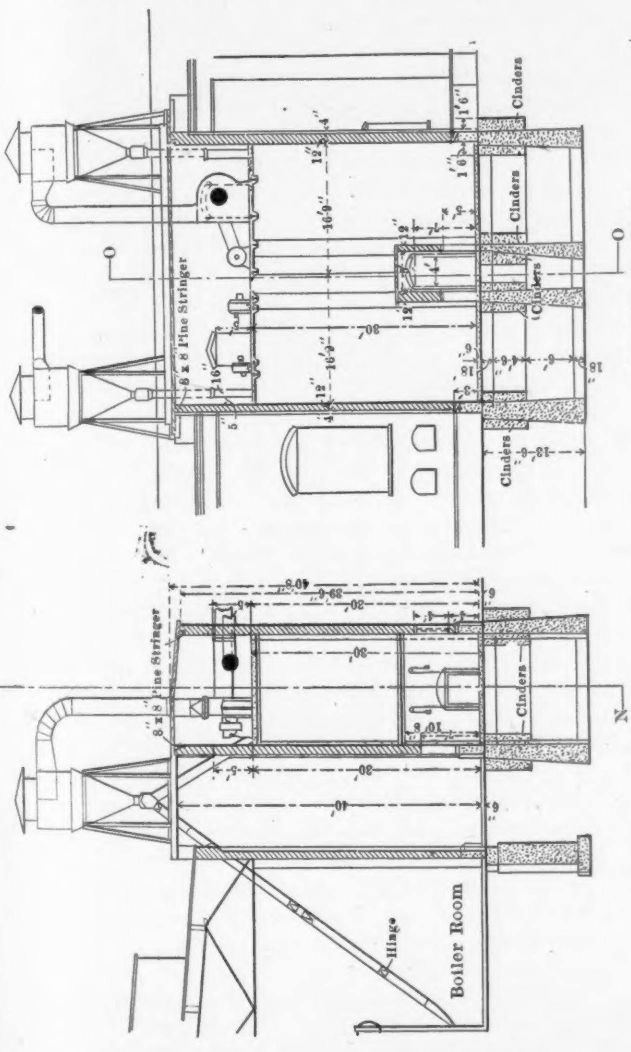
POWER HOUSE INTERIOR.
PUMP PIT AT THE LEFT.

DELIVERY OF SHAVINGS TO BOILERS.

ANGUS LOCOMOTIVE AND CAR SHOPS, MONTREAL.—CANADIAN PACIFIC RAILWAY.

DATA CONCERNING LARGE CRANES.—ANGUS SHOPS, CANADIAN PACIFIC. RAILWAY.

Location in Shops.	Number of Cranes.	Capacity, Main.	Capacity, Auxiliary.	Span.	Lift of Hook.	Height of Crane.	Motors—H.P. Drum Hoist.	Motors—H.P. Trolleys.	Motors—H.P. Bridge.	Motors—H.P. Auxiliary Hoist.	Speeds in feet, per min. Loaded. } Main Hoist	Speeds in feet, per min. Loaded } Trolleys.	Speeds in feet, per min. Loaded } Bridge.	Speeds in feet, per min. Loaded } Aux. Hoist.	Crane Clearance at Center.
Erecting shop	2	60	10	76 ft. 5 ins.	25 ft. 8 ins.	10 ft. 6½ ins.	50	7½	50	27	10	100	250	25	24 ft. 10 ins.
Machine shop	1	15	—	51 ft. 11 ins.	25 ft. 8 ins.	6 ft. 6¼ ins.	27	3½	27	—	19	125	300	—	25 ft. 6 ins.
Machine shop	1	10	—	51 ft. 11 ins.	25 ft. 8 ins.	6 ft. 2 ins.	27	3	27	—	27	150	300	—	25 ft. 6 ins.
Boiler shop.......	1	20	5	76 ft. 5 ins.	25 ft. 8 ins.	——	25	5	25	10	12	100	250	20	25 ft. 6 ins.
Midway	1	10	—	77 ft. 0 ins.	30 ft. 0 ins.	——	25	3	25	—	25	125	250	—	——
Foundry (outside).	1	10	—	60 ft. 0 ins.	30 ft. 0 ins.	——	25	2	25	—	25	125	350	—	——
Foundry (inside)..	1	10	—	60 ft. 0 ins.	22 ft. 0 ins.	——	25	2	25	—	25	125	350	—	——



SECTIONS THROUGH SHAVINGS STORAGE VAULT.

Distribution.—From the switch board the feeder lines pass into a 10 by 12 ft. brick tower built into the power house wall. From there the distribution is by bare copper on poles built up of four 15.6 lb. Z bars with a ⅜-in. web plate. These are 62 ft. high, including the portion under ground 8 ft. and they provide for 7 cross-arms. Fourteen of these poles take the feeders past the blacksmith shop between the car machine and the truck shops to the locomotive shop, with branch connections to all the other buildings. The cables are 250,000 c. m. bare copper, in 100 ft. spans with a sag of 2½ ft. in summer. All cables are "dead ended" at the entrance to all buildings. The wiring in the buildings is partially of open cleat work with slow burning weather proof wire and partially conduit work with rubber covered wire. For every 100 h. p. of motor circuits an oil circuit breaker and no-voltage release is provided. The lighting scheme includes 400 Canadian General Electric, 110-volt, incandescent arc lamps and nearly 4,000 110-volt 16 candle power incandescent lamps. The yards are lighted by 50 6.6 amperes, series, alternating, enclosed arc lamps.

Power for the inside lighting is taken from the A. C. generator cables, the voltage being transformed down to 110. The transformers are hung on the outside walls of the wood working shops and the columns of the other buildings. Only one size 10 k.w. is used. These are General Electric Type H., oil cooled. The secondaries are carried to cabinet panels in conduits or on cleats according to the construction of the building. The buildings are lighted with a mixed system of 16 c.p. 110-volt incandescent lamps and multiple arc lamps of 110 volts and 6.6 amperes. Drop lights are placed over each machine. Wires are carried through floor conduits to the benches. In the passenger car shops plugs are provided at all pillars. The arc lamps are hung about 20 ft. above the floor and usually along both sides of the shops, about 50 ft. apart. The lighting of the locomotive shop will be referred to again.

Electrical Conditions.—Because of the extent of this plant and the combination of car and locomotive work in one shop group the transmission problem was both important and difficult. The advantages of alternating and direct current which were considered in connection with this shop problem are summed up as follows:

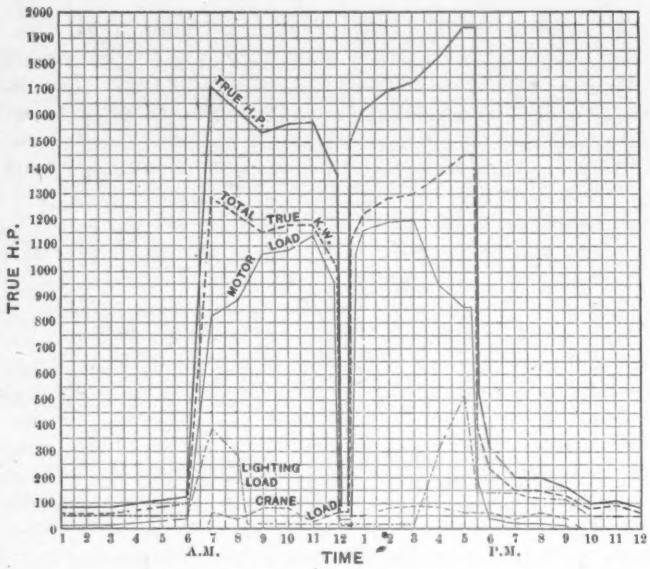
Advantages of A. C.—1. No commutators or brushes on the motors—in the grit and the fumes of the foundry this is important. 2. Safety.—In the wood shop, with its fine and almost explosive dust the fire hazard is greatly reduced with motors of the A. C. type. If D. C. motors are used they must be completely enclosed, which is expensive (in this case the lack of ventilation is a source of danger). 3. Transmission over long distances.—The A. C. has an advantage in greater flexibility for extension over long distances. In case of necessity of pumping water or extending the lighting system to a long distance, the A. C. is and the D. C. is not suitable. 4. Independent supply.—If A. C. is used, power may be purchased from commercial electric companies, which is usually not practicable with D. C. current. 5. Repairs.—A. C. motors will run with less repairs and attendance. 6. Tendency.—A. C. current is rapidly displacing D. C.

Advantages of D. C.—1. For this plant it would have been cheaper in first cost by about $11,000. 2. No motor generators for variable speed tools and cranes, or transformers for lighting would be required in the shops. 3. Slower speed motors could be used with direct current. This would help in belting in some cases to slow running shafts, especially in the machine shop, and it would be advantageous in other shops. 4. But one universal system of wiring would be necessary. 5. All apparatus except motors is confined to the power house, where it may be easily cared for. 6. Simpler wiring, as all current would be distributed from the power station at 250 volts direct to all motors and lamps. 7. Better commercial competition for motor and generator contracts.

Mr. Dietrich is of the opinion that D. C. variable speed motors should be used for all variable speed machines. (Editor's Note.—There is not enough variable speed power in the locomotive shop to obtain the full value of electric driving.) Of the six methods of varying the speed of polyphase motors the following are mentioned as possible: (1) Varying the number of poles; (2) varying the alternations applied; (3) Motors in tandem or series—parallel; (4) secondary run as single phase; (5) varying the resistance of the secondary; (6) vary-

ing the electro-motive force of the primary, with constant secondary resistance—but one (5) is used here and it is not entirely satisfactory, but the others could not be used to advantage.

LOAD FACTORS.—In general the generator capacity should be slighty in excess of one-half of the total rated motor capacity. The load factors from each department, as taken from actual readings are: Planing mill, 61 per cent.; blacksmith shop, 31 per cent.; locomotive shop, 34 per cent.; cabinet shop, 37 per cent.; frog shop, 26 per cent.; foundries, 70 per cent. One of the engravings presents the output curve for the generators for December 22, 1904. The maximum load, at 5 p. m., was



CURVE SHOWING POWER DISTRIBUTION.

1,940 h.p., the average from 7 a. m. to 5.30 p. m. was 1,560 h.p. The load factor was 80 per cent. and the power factor of the maximum load 68. For the entire 24 hours the average load was 850 h.p. and the load factor 44 per cent. This was a stormy day, requiring a large lighting load.

A summary of information concerning the larger cranes of this plant is given in the accompanying table.

Valuable assistance in connection with this article was rendered by Mr. H. H. Vaughan, superintendent of motive power; Mr. W. N. Dietrich, electrical engineer, and Mr. G. B. Mitchell, resident engineer.

WELDING FRAMES UNDER ENGINES.—This work has become a very important factor in many repair shops, and as the idea originated with us at the Renovo shop on the P. & E. R. R., we will no doubt be pardoned for taking such interest in the question. We made our first weld in August, 1899, and have successfully carried on the method up to date. We have repaired 50 or more frames successfully, and always do it by this method when it is possible to get our furnaces around the broken parts.—J. W. Russell, *before National Railroad Master Blacksmiths.*

BANKED FIRES FOR FIRE PROTECTION.—A well banked ordinary factory boiler may be relied on to promptly operate a fire pump at the rate of 1,000 gals. per minute. Banking such a boiler so as to maintain 50 lbs. steam pressure need not require more than 800 lbs. of coal per day. In a test made at a New England mill four fire streams were had in 13 minutes when the boiler had been banked for a week. Four tests on boilers in different mills showed that an average time of 1 hour 30 minutes was required to get up 50 lbs. of steam on cold boilers. These tests were conducted by the Associated Factory Mutual Fire Insurance Companies in order to determine the importance of keeping up steam for fire purposes. *Engineering News*, Nov. 3, 1904, page 401 contains a complete account of the tests.

PRAIRIE TYPE FREIGHT & PASSENGER LOCOMOTIVE.

CHICAGO, BURLINGTON & QUINCY RAILWAY.

This road has received 50 passenger and freight locomotives from the Brooks Works of the American Locomotive Company of the 2—6—2 type, which are a logical development of the previous designs of this type illustrated in April and July, 1900, pages 103 and 217; May, 1901, page 135, and November, 1902, page 343, the present design being the fourth of this type on this road. The first of this class was the pioneer of the present development of wide fireboxes for bituminous coal. All of these engines have had outside journals for the trailing wheels and the splices with spreading of the back ends of the frames, illustrated in April, 1900, page 105. The tractive effort of each of these designs is as follows: Class R, 21,860 lbs.; Class R2, 25,500; Class R3, 28,300 lbs., and Class R4, 35,050 lbs.; thus indicating a remarkable advance of from 21,860 to 35,060 lbs., or almost exactly 60 per cent. in four years in a continuous series of locomotives designed in accordance with a systematic plan by the railroad officials. In these days of hitting and missing, it is a pleasure to record facts which reflect a definite plan in locomotive progression. It indicates that the officials understand their conditions and that they know what they want. These locomotives were built throughout from the railroad company's drawings.

All of these engines have piston valves. In the present design they are 12 ins. in diameter, placed between the bars of the frames and almost exactly central therewith. With this low location and inside admission valves with direct motion the rocker boxes are supported on the lower bars of the frames and but a single rocker arm is required. This is a novel and interesting arrangement, giving a reduced cylinder clearance, light cylinder castings and open eccentric rods.

The Burlington trailer truck is used on all Class R engines with boxes in pedestals, with roller bearings over them. The trailer eqqualizers connect with a transverse equalizer in front of the wheels.

The boiler is straight and has 301 2¼-in. tubes, 19 ft. long. The tube sheets are arranged so that superheaters may be applied, in fact a trial of the Cole superheater is to be made in one of these engines. These tenders are very large, providing for 16 tons of coal and 8,000 gals. of water. Sheet steel shields, open at the top, prevent coal from falling off. For coal gates, planks in sockets are used, with spaces between them. All of the Burlington locomotives have gates across the gangways. Several of these engines are to burn lignite, and this feature and the tenders will be referred to again. These engines are used in fast freight and heavy, moderate speed passenger service.

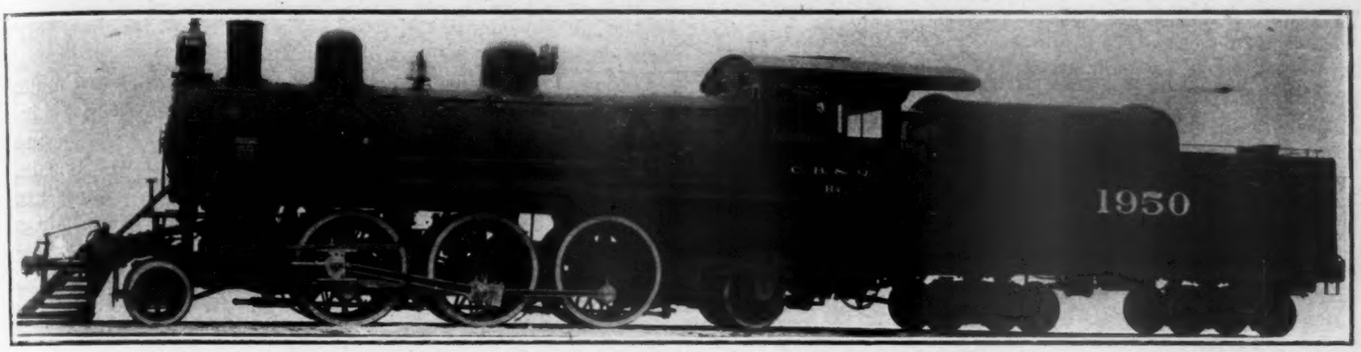
That the Burlington is using the Prairie type so successfully supports the two-wheel leading truck in a forcible way, as it is by no means free from sharp curves. The leading dimensions of this locomotive are as follows:

GENERAL DIMENSIONS.	
Gauge	4 ft. 8½ ins.
Fuel	6 engs. bituminous coal; 6 engs. lignite
Weight in working order	212,500 lbs.
Weight on drivers	154,000 lbs.
Wheel base, driving	13 ft. 4½ ins.
Wheel base, total	30 ft. 8½ ins.
Wheel base, total engine and tender	62 ft. 2¾ ins.
Tractive power	35,053 lbs.
CYLINDERS.	
Diameter	22 ins.
Stroke of piston	28 ins.
Diameter of piston rod	4 ins.
Kind of piston packing	Dunbar
VALVES.	
Kind	piston
Travel	5¾ ins.
Steam lap	1⅛ ins.
Exhaust lap	⅛ in.
WHEELS.	
Diameter of driving wheels outside of tire	69 ins.
Diameter of driving wheel centers	62 ins.
Material of driving wheel centers	cast steel
Diameter of engine truck wheels	37¼ ins.
Diameter trailing truck wheels	42½ ins.
Diameter and length of driving journals	9½ ins. by 12 ins.
Diameter and length of trailing truck journals	8 ins. by 12 ins.
Engine truck, kind	2-wheeled radial
Engine truck journals	6 ins. by 10 ins.
BOILER.	
Style	radial stay, straight top
Outside diameter of first ring	70 ins.
Working pressure	210 lbs.

Firebox, length	109 ins.
Firebox, width	73 ins.
Firebox plates, thickness	sides, ⅜ ins.; back, ⅜ ins.; crown, ⅜ ins.; tube sheet, ½ in.
Firebox, water space	front, 4½ ins.; sides and back, 4 ins.
Tubes, number	301
Tubes, diameter	2¼ ins.
Tubes, length	19 ft.
Tubes, gauge	No. 11
Heating surface, tubes	3,343 sq. ft.
Heating surface, firebox	170.9 sq. ft.
Heating surface, total	3,513.9 sq. ft.
Grate, area	54 sq. ft.
Gate, style	Rocking
Exhaust pipe	single
Smoke stack, top above rail	15 ft.

TENDER.

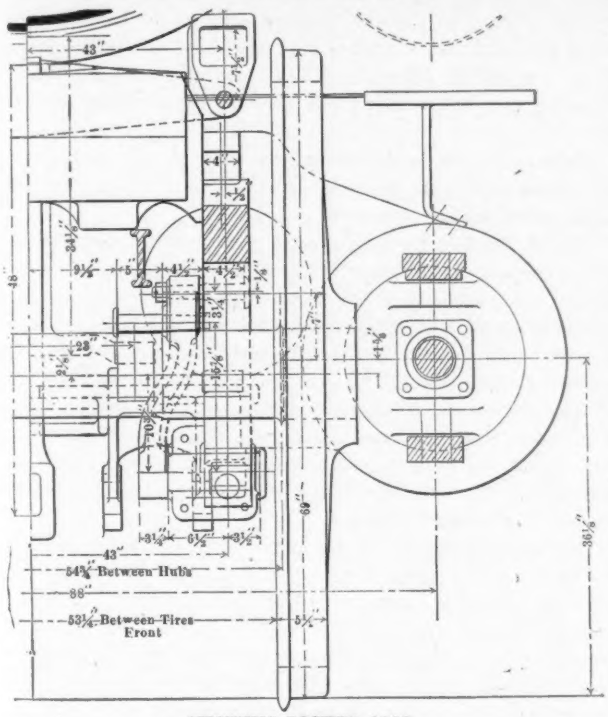
Style	water bottom
Wheels, diameter	33 ins.
Journals, diameter and length	5½ x 10 ins.
Tender frame	12 in. channel
Water capacity	8,000 gals.
Coal capacity	16 tons.



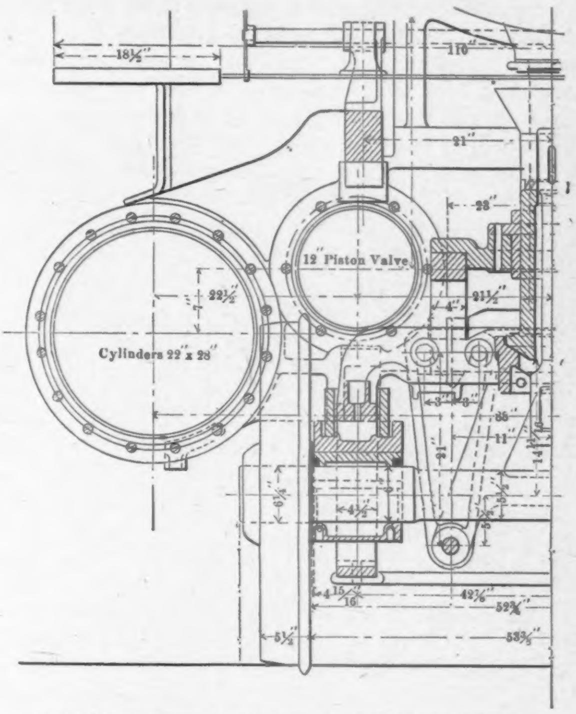
PRAIRIE TYPE PASSENGER AND FREIGHT LOCOMOTIVE.—C., B. & Q. RY.

Designed by F. H. CLARK, *Superintendent of Motive Power.*
C. B. YOUNG, *Mechanical Engineer.*

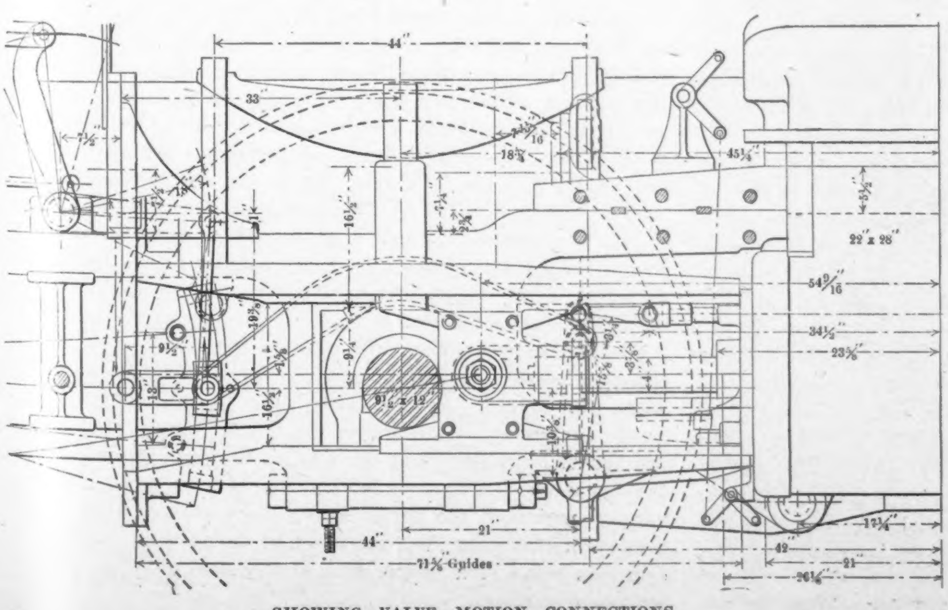
AMERICAN LOCOMOTIVE COMPANY, BROOKS WORKS, *Builders.*



SHOWING ROCKER ARM.



SECTION THROUGH CYLINDER AND VALVE CHEST.



SHOWING VALVE MOTION CONNECTIONS.

THAWING WATER PIPES ELECTRICALLY.—The Public Service Corporation of New Jersey derived a gross revenue of $12,000 in a year by using electric current to thaw out water pipes. A special portable transformer for this purpose is made by the General Electric Company. Current is connected to the pipe to be thawed, and the pipe itself is heated by a heavy current, whether it is above or below ground. Care is required to make good contacts with the pipe or faucets, in order to guard against burning them. A scheme of this kind should be very useful about railroad shops and roundhouses, where electric current is usually available, in view of the fact that freezing of pipes is a very serious matter in Northern climates.

NEW ROUNDHOUSES AT ELKHART.

LAKE SHORE & MICHIGAN SOUTHERN RAILWAY.

(*For previous article see page* 42.)

It is significant of the progress in roundhouse construction and equipment that the houses at Clinton, Iowa, Chicago & Northwestern (AMERICAN ENGINEER, January, 1901, page 25) at Collinwood, Ohio, Lake Shore & Michigan Southern (October, 1901, page 305) and at Rensselaer, N. Y. (February, 1902, page 49) are already obsolete and offered little of interest in drawing up the plans of the new houses at Elkhart.

The present problem is to provide a house which may be heated and ventilated and then to equip it with the best possible facilities for rapid work. The roundhouse has really become a shop for running repairs and the housing function is secondary. Because of their importance special attention is given, in this description, to the boiler washing and water changing system.

WASHOUT SYSTEM.—This interesting system includes two sets of heaters in an annex to the power house combined with piping extending through the pipe tunnel entirely around both roundhouses. The tunnel piping consists of an 8-in. blow-off and 4-in. hot and cold water pipes. Connections are brought from the main pipe tunnel to each post in both roundhouses, consisting of a 2-in. cold water pipe, a 2-in. hot water pipe, a 4-in. blow-off and a 1-in. air pipe. At each post is an assembling connection, or monitor, which is shown in Fig. 7 and again in Fig. 9. At each of the posts connections are provided for blowing-off from the water leg and from the dome, and both hot and cold water are available for washing out and filling up. The operation of the system is illustrated by an ideal diagram, Fig. 12, simplified to show the principles. Seven separate conditions are illustrated. The locomotive at the left is connected for blowing down the water only. This passes through the 8-in. pipe to the lower or preliminary heater, the overflow passes to the sewer, and vapor from the surface passes away through the upper or steam heater. The pump shown in this engraving is connected to the cold water suction. It will pump cold water to each post in the roundhouse, or it will pump cold water into the coil in the lower heater from which it passes to the coil in the steam heater and thence into the hot water main to all the posts for washing out or filling boilers. By this arrangement the heat from the blow-off water, or from steam blown from the domes of the locomotives, is utilized to heat water for washing and filling. Live steam may be applied to the upper or closed heater in case it is required.

The second locomotive in Fig. 12 is connected for blowing down the water on both sides of the fire box and blowing off steam from the dome. The third is connected for blowing off steam from the dome only. The fourth for washing out. The fifth for changing water under pressure, in which case the dome connection brings hot water into the boiler. The sixth is connected for refilling with hot water, and the seventh for washing out with hot water.

This system can furnish water at a temperature of 350 deg. by applying live steam to the upper heater, but usually waste heat from blowing off will be entirely sufficient without using live steam. When changing the water it is done without drawing fires. It is not the intention to knock down the fires when the water is to be changed, the water being blown off at about 100 lbs. pressure and the amount blown out from the bottom of the boiler replaced at the top with water heated to 350 deg. About half an hour would be required for this water changing, and this installation is expected to greatly reduce the number of times of washing out; it will also relieve the boiler from destructive stresses from cooling down and will save about 75 per cent. of the fuel required to get up steam again. Both heaters combined have a capacity of 5,200 gallons of water. The water and steam blown off from an ordinary locomotive will raise 5,200 gallons, the combined capacity of both heaters, from 50 to 210 deg. Washing out is done with water at a temperature of from 110 to 135 deg. About 3,000 gallons are required to thoroughly wash a boiler, 1,500 gallons of hot water from the heaters mixed at the turret with say 1,500 gallons of cold water. About 2,500 gallons are required to fill the larger locomotive to 2 gages. In ordinary service probably about 2,000 gallons will be used in washing out. In view of the fact that 1½ hours must be allowed to getting steam up to 110 lbs. from cold water the importance of the improvements described on page 42 of the February number is readily realized.

Connections for the steam domes to the monitors are made through 3-in. pipes extending up the posts, branching into 3-in. pipes in each direction, reduced to 2½-in. pipes for the second pit at each side of the monitor. Down connections of 2-in. pipe reach the domes by means of flexible joints. These are attached to the dome blow-off nipples by means of couplings having interrupted threads for rapid attachment.

In order to keep the hot water circulating in the roundhouse piping a 1-in. circulating pipe runs from the ends of the hot water mains in the roundhouse to the power house, consisting of four pipes in all, each fitted with and controlled by a thermostatic valve, which closes automatically when the water at the terminals of the hot water mains reaches 200 deg. These open automatically when the temperature falls below this point. These valves are in the power house and thermometer cups permit the attendants to keep watch of the temperatures. The circulating pipes discharge into the pump suction, thus keeping the hot water pipes at a temperature of 200 deg. or above.

Provisions are made for taking care of the sludge from the hot wells and also to flush out the roundhouse blow-off pipe with water under pressure.

STEAM BLOWER PIPING.—A 3-in. steam main is carried around the houses and connected to a 4-in. main in the pipe conduit. From the overhead main 1-in. pipe connections are brought down to about 6 ft. from the floor and are fitted at the top and bottom with flexible joints for conveying the steam to blower pipes on the locomotives. In this way steam may be attached to any blower in either of the houses. The valves are at the 3-in. main and are controlled from the floor by means of ½-in. round rods with universal joints. This 3-in. main is located 35 ft. from the outer wall of the building and is attached to the roof trusses.

AIR PIPE SYSTEM.—Three-quarter-in. air pipes are brought to each of the drop pits. The main air pipes are brought through the pipe conduits to the roundhouse. A 2-in. air pipe extends around each house and is led to the monitors, terminating in connections fitted with Westinghouse cut-out cocks.

AIR SIGNAL TEST.—The passenger house is piped along the inner walls so that each passenger engine air signal may be tested with a loop of piping equivalent to that of a 16-car train. This pipe is looped down at the inside wall of the house on alternate posts to within 6 ft. of the floor, so that a hose connection may be made to the tender coupling. This signal testing line is charged from the main air pipe. At each engine it is equipped with a Westinghouse conductor's valve and with a gage, the piping being so arranged that each engine can be cut into the air signal loop at any pit by means of the valves shown in Fig. 6. These facilities render it possible to test the locomotive signal at the house, so that repairs can be made if necessary before the engine couples to the train. Uncertainty as to the condition of an engine equipment is thus eliminated when the test is made after coupling to the train.

STEAM HEATING.—The buildings are heated by direct steam, using exhaust steam from the power house and live steam from the boilers. A 6-in. main runs around the passenger house and an 8-in. main serves the freight house. The houses are heated by radiators in the pits, in the drop pits and round the houses under the windows. The returns are brought to vacuum pumps in the power house, there are no valves in the connections between the radiators and the vacuum returns, the openings being of a proper size to automatically take care of condensations.

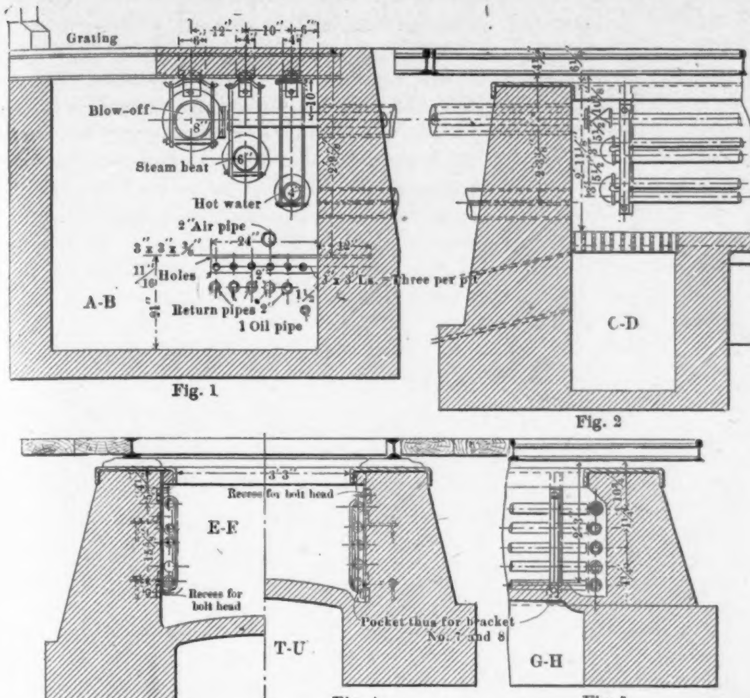


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5

SECTIONS THROUGH PITS AND TUNNEL.

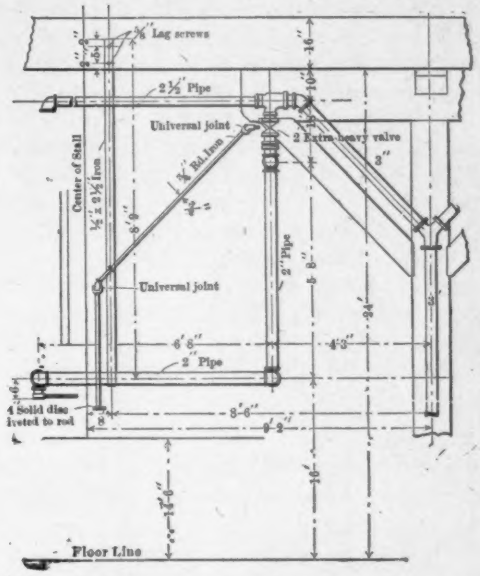


FIG. 8.—DOME CONNECTION FOR BLOWING OFF AND FILLING BOILERS.

A temperature of 60 deg. F. is guaranteed throughout all of the buildings in zero weather. All the ordinary pits have five coils of 2-in. pipe on each side and across the ends. On the outside wall beneath the windows a four-coil radiator, 20 ft. long, is placed opposite each pit. In the pits the pipes are protected by overhanging rail supports, as shown in the cross

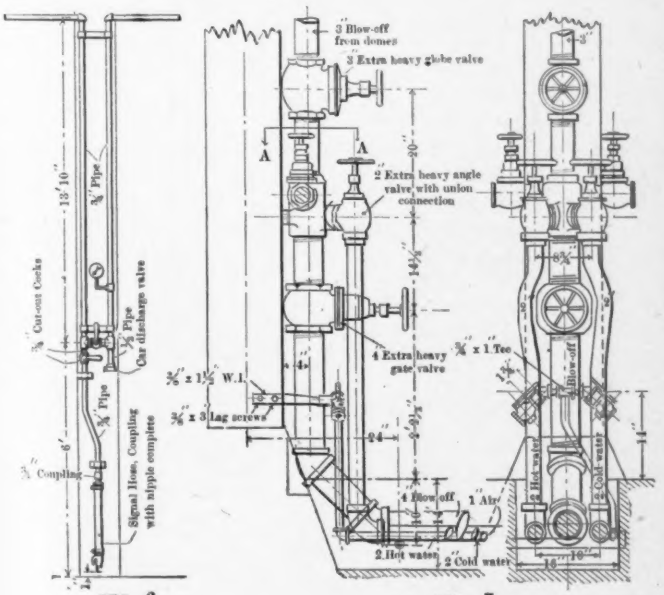


FIG. 6. FIG. 7.

PIPING FOR TESTING TRAIN SIGNALS AND POST MONITORS IN ROUNDHOUSE.

section of one of the pits, Fig 3. The drop pits are provided with four coils of 2-in. pipe extending entirely around the walls. The feed pipe for the radiator columns in the roundhouse runs in the main tunnel, a portion of the roof of which is covered with a grating, which makes this steam main a portion of the heating system, Fig. 1. All of the pipes are assembled at one side of the conduit, so that dirt which may fall through the grating may not reach the pipes. This tunnel may be flushed from end to end with water for cleaning. The condensation water from the feed main and radiators returns to

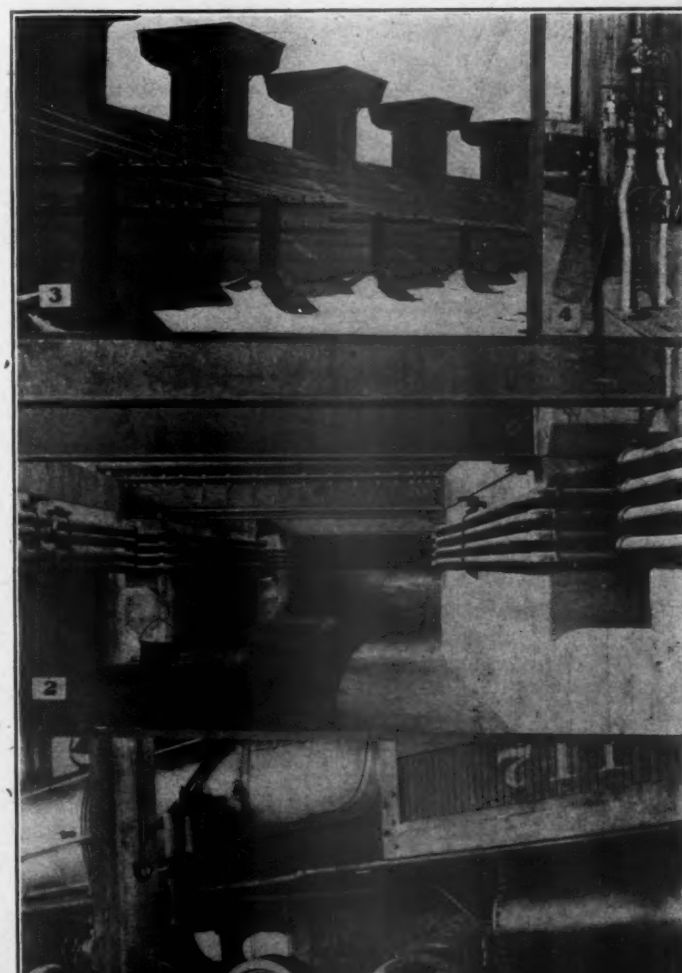


FIG 9.—(1) Blow off connection in use; (2) One of the drop pits; (3) Wire posts on roof; (4) Post pipe monitors.

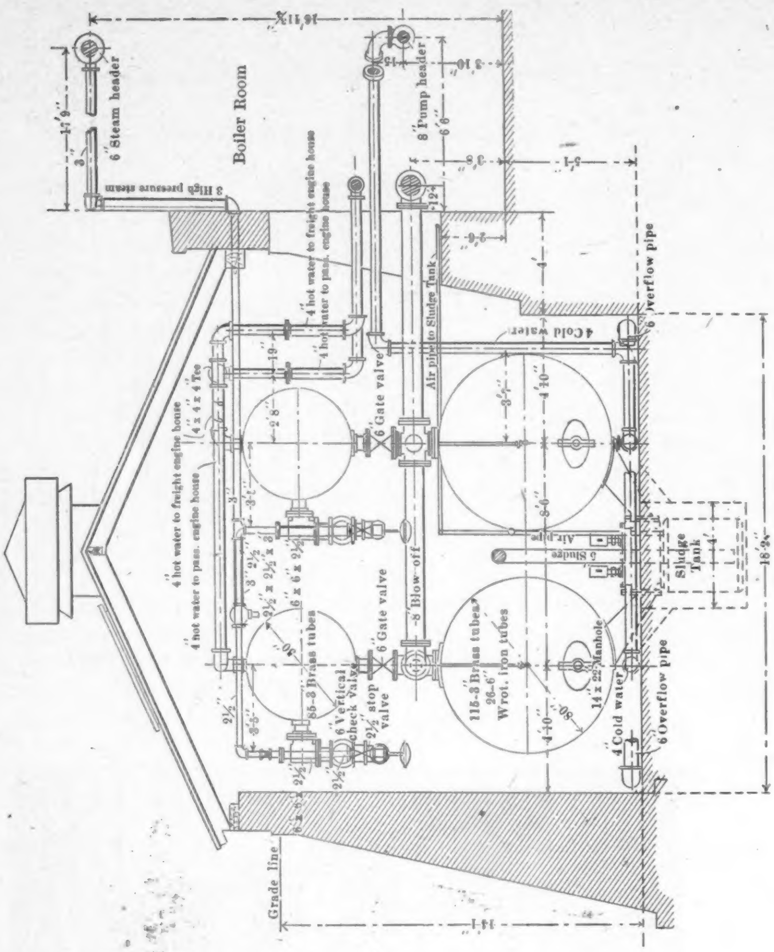


FIG. 11.

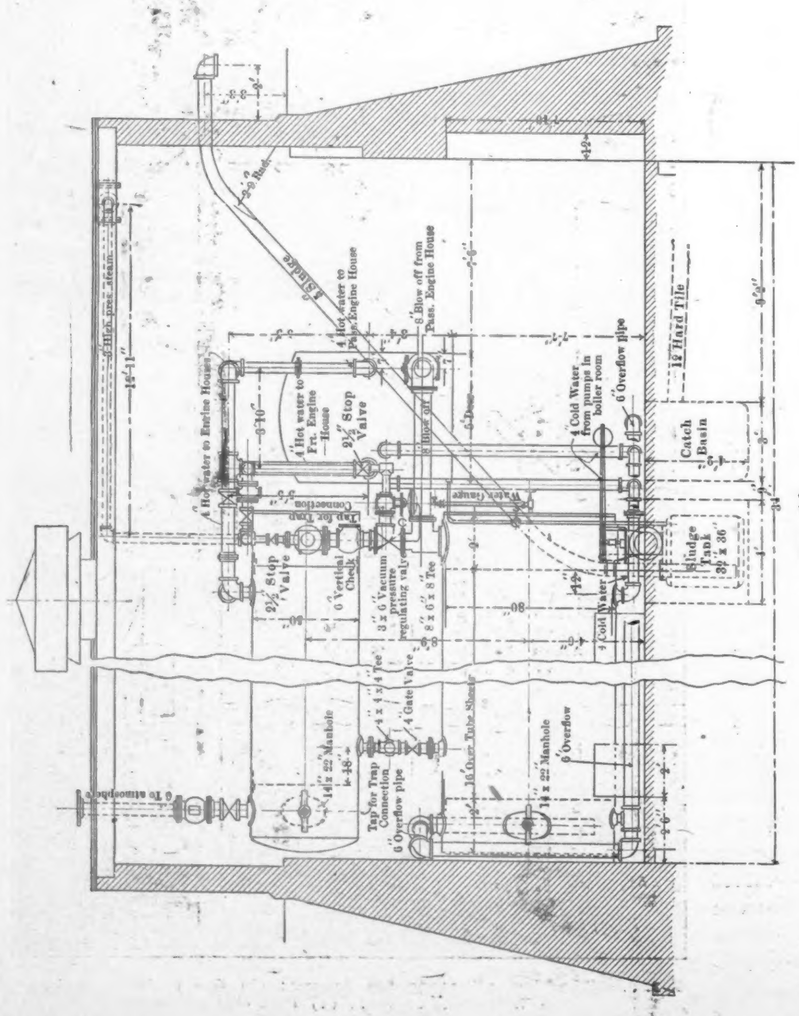


FIG. 10.

SECTIONS THROUGH POWERHOUSE ANNEX, SHOWING HEATERS.

the feed water heater in the boiler and is used for feeding the boilers. Three lbs. back pressure is used at the power house. A steam pipe is run out to the ash pits for use in thawing out ash pans when necessary.

Calculations for the heating system were made on a basis of 8 boiler h.p. per stall for heating. There are 665 ft. of 2-in. pipe in each pit. One square foot of pipe heating surface was allowed for 100 cu. ft. of volume of the roundhouses. Each stall has 475 sq.

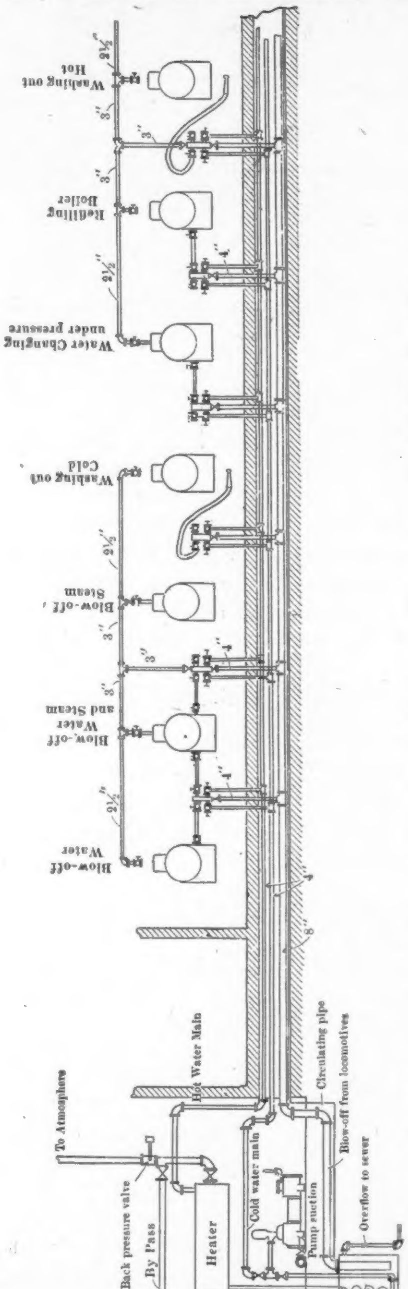


FIG. 12.—DIAGRAM SHOWING HOW WASH-OUT AND BOILER FILLING SYSTEM IS USED

ft. of radiating surface. For the office building, shop and other rooms a somewhat smaller proportion was allowed.

The washout, heating and other piping systems were designed by the mechanical department of the railroad company and were completely furnished and applied by the Erie Heating Company of Chicago. The ingenious assembling connections, or monitors, for the posts in the roundhouse, were devised by Mr. R. B. Kendig, mechanical engineer of the road.

LIGHTING.—The general lighting is by means of enclosed arc lamps at each post near the engine cabs. Sockets for portable connections are provided at each post, Fig. 9—(1), and at each side of each of the fire walls two incandescent lamps are provided and one receptacle for a plug. The wiring inside of the house is all protected in piping. The distributing mains pass around the roof outside of the building to posts over each pit, Fig. 9—(3), thus keeping the wires entirely out of the influence of the gases. Four arc lamps are used for inside lighting and 9 for outside. Electric power is at the present time secured from the Elkhart Electric Company. It is received at 2,200 volts, 7,200 alternations and 60 cycles and is transformed to 110 volts and 2-phase for lighting and 440 volts and 3-phase for the motors. A 20-h.p. motor operates the machine shop. Two 10-h.p. motors drive the two turntables and three motors are used at the coaling station and 20 h.p for hoisting coal and 5 h.p. for operating the mixer and 3 h.p. for hoisting sand.

DROP PITS.—Eight drop pits in all are provided, four driving and four truck pits in each house. These are arranged so that three independent driving wheel and three independent truck wheel pits are available in each, and one track in each house has a driving wheel and truck wheel pit upon the same track. These pits are equipped with pneumatic telescope air jacks, similar to those in use by the C., B. & Q. and C. & N. W. railways. The heating piping for the drop pits is continued on one side of all the pits in each house; the piping on the other side is cut up into sections at the drop pits and other pits; only one valve is used to control the heating; the outlets of this piping connect to the vacuum pumps. The purpose of so many drop pits is to prevent delays of engines which may require work on wheels or boxes. As stated in another paragraph a great deal of repair work will be done here.

SMOKE JACKS.—These jacks are of an original design, having a cross section 50 x 36 ins. at the roof, tapering to 108 x 36 ins. at the bottom, where the jack is flared to 12 ft. x 5 ft. 6 ins. An annular opening 6 ins. wide around the jack at the roof allows smoke and steam to escape out of the peak of the building. They are of wood, protected by asbestos paint and are very effective.

BOILER HOUSE EQUIPMENT.—Three 264-h.p. Cahall, horizontal water tube boilers furnish steam. They are equipped with shaking grates. The stack is steel, 125 ft. high with a concrete base 17 ft. high. It is lined its whole length with fire-brick, backed by ordinary brick. A 200-ft. Franklin compressor furnishes compressed air and two Fairbanks-Morse duplex feed pumps with 7 and 4½ by 10 in. cylinders, such having a capacity for feeding 900 h.p. of boilers are supplied. Feed water is passed through a No. 26 Cochrane feed heater.

MACHINE SHOP EQUIPMENT.

1—16 in. by 6 ft. Davis engine lathe.
1—30 in. by 14 ft. Schumacher & Boye lathe.
1—24 in. Aurora sliding head drill press.
1—48 in. Dresses, plain radial drill.
1—48 in. by 8 in. Keystone grinder.
1—Oster hand pipe machine (1 to 4 in. pipe).
1—Hydraulic bushing press.
2—40 in. forges for blacksmith and coppersmith.
1—24 in. Flather shaper.
1—surface plate.
1—upsetting block.
1—anvil.
4—portable work benches.
1—1,000 lbs. jib crane (blacksmith).
1—200 lbs. Bradley compact hammer.
1—No. 3 Buffalo type B volume blower.
1—No. 3 Underwood portable cylinder head facing machine.
1—Underwood portable cylinder boring bar.
1—No. 2 Underwood portable crank pin truing machine.
1—26 in. Underwood valve seat planer.
2—3 ton Franklin portable hoists.
2—cranes for loading material on tender tanks.
Hyatt roller bearings for all line shafting.

These houses now turn an average of 161 locomotives per day. This shop equipment is intended to provide for all running repairs, such as changing tires, whole or parts of sets of flues, light repairs to machinery, necessitated by wear or accident, in fact, to take care of all but general repairs or frame breakages. All main line passenger locomotives between Toledo and Chicago and all through freight engines between these points will be washed out at Elkhart, this work being now concentrated here which was formerly done at Air Line Junction, Toledo and Englewood. By this concentration the forces will be brought together at Elkhart and the work of washing out and repairing will be greatly facilitated.

This is not an inexpensive roundhouse plant, but it is fully justified as a business proposition in the returns which will come from prompt terminal service and the saving of wear and tear of boilers incident to the usual methods of washing out. The admirable oil house system and other details will be described later.

MELTING ICE WITH HOT WATER.—A by no means unimportant additional advantage of this hot-water service at Elkhart has just been brought to our attention. In the recent cold weather an engine came in for roundhouse work on the machinery and tender trucks. It was a mass of ice, with tender springs rigidly frozen up and the motion work inaccessible from ice. The engine was wanted in an hour. Ordinarily, the ice would not be melted off in two or more hours. By turning a stream of hot water on it, the ice vanished in a few minutes, and the engine was ready in less than one hour.

BEST FORM OF ENGINE HOUSES.—In a report to the Association of Railway Superintendents of Bridges and Buildings, the following advantages of rectangular and round engine houses were enumerated:

Rectangular Engine Houses.—1. Economy of ground space occupied.

2. Uniform room at front and rear of engines while in house, making it easier to work on engines.

3. Economy in construction of walls, floor and possibly roof.

4. Economy in piping for heating, water, steam and lighting.

5. Opportunities for pit drainage, which could be straight, open drain under transfer table.

6. Erecting shop, machine and washout section can be in connection with engine house, and either can be utilized as circumstances may require, thus concentrating buildings, men and tools.

7. Only one, or perhaps two, outside doors required; less heating and repairs.

8. More open to inspection and more uniform light.

9. No trouble with turntable radial tracks in winter.

10. Less trouble with snow and ice in turntable pits and around engine house doors.

Circular Engine Houses.—1. Close proximity to turntable, making the despatching of engines a matter of very little delay.

2. The handling of one engine between house and turntable without any relation to any other part of the house.

3. Saving of expense of transfer table and cost of operating.

4. Economy of ground space when track approaches and outside turntable for rectangular engine houses are considered.

The steam roads on which electrification is clearly advisable include (1) Lines operating very frequent trains and having numerous stops. (2) Tunnel roads, where electrification is advisable for the sake of ventilation, irrespective of operating costs. (3) Terminals in large cities, especially if partly operated through tunnels. (4) Lines on which, from franchise or other conditions, the use of steam is not permissible.

That class in which electrification is at present inadvisable include (1) All trunk lines operating under usual conditions and normal distribution of passenger and freight traffic. Generally it may be assumed that trunk lines operating trains at greater than 30 minutes headway cannot show sufficient economies and gains of traffic by electrification to cover the interest and depreciation on cost thereof. With trains operating more frequently than with 30 minutes headway individual cases may merit detailed study. (2) Branch lines depending largely or entirely on freight traffic and other branch lines on which a very substantial increase in passenger traffic cannot be developed by such more frequent service as electric equipment would make readily possible.—*J. G. White, International Engineering Congress.*

REPORT OF COMMITTEE ON POWER.

CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.

DESCRIPTIONS OF STANDARD TYPES OF LOCOMOTIVES.

(*For previous article see page* 40.)

The committee proposed seven standard locomotives as a basis for the purchase of power for these lines for the immediate future. These include a heavy and medium weight consolidation, two ten-wheel classes, Pacific type, Atlantic type and a six-wheel switcher. These locomotives are represented in the accompanying table of comparative dimensions, and five of the seven are shown in the outline diagrams.

HEAVY CONSOLIDATION.—This locomotive is recommended for very slow freight trains on grades as great as 1 per cent., its weight being up to the present capacity of bridges and tracks. This resembles locomotives already in service, but the committee recommends a reduction of steam pressure from 200 to 185 lbs., in order to reduce boiler repairs. (It should be noted that the committee recommends 185 lbs. boiler pressure for all their standard locomotives, with the exception of the Pacific type, which will be referred to again.) The heavy consolidation locomotive will be used for grades and coal traffic, where the movement of trains is slow, and where 57-in. wheels and a tractive effort of 40,000 lbs. will be required.

MEDIUM CONSOLIDATION.—This is a much lighter engine, and is recommended for use on a large portion of the lines where the condition of track and bridges will not permit of using the heavier locomotive. Its tractive effort is 36,200.

TEN-WHEEL DESIGNS.—Two 4—6—0 designs are recommended, so arranged that with no other changes, except in the diameter of the wheels, a passenger locomotive may be made available for fast freight service. This engine is not too heavy to be run generally over the entire system. With 69-in. drivers the tractive effort will be 28,680 lbs., and with 63-in. wheels it will be 31,400 lbs., giving a factor of adhesion of 4.24.

PACIFIC TYPE.—For very heavy passenger service on divisions with steep grades this type, with a deep firebox and large amount of heating surface, great steaming capacity, and high tractive effort, may be more generally depended upon than any other type of locomotive. The present Rock Island engine No. 801 (See AMERICAN ENGINEER, October, 1903, page 351) is taken as a basis for this design. The cylinders are 22 instead of 21 ins.; the tractive power increased from 28,600 lbs. to 31,000 lbs.; the total weight from 195,000 to 203,000, and the trailing truck with an inside bearing gives place to one with outside bearings. The grates are 68 ins. wide, being uniform with the others.

ATLANTIC TYPE FAST PASSENGER.—This engine is similar to the C. & E. I. engines built at the Schenectady works, except that 73 instead of 79-in. drivers are suggested, the steam pressure is reduced to 185 lbs., and the firebox reduced to 68 ins. in width, so that standard grate bars may be employed. (The width of all fireboxes in this series of designs is uniformly 68 ins.) This engine is designed so that 79-in. wheels may be applied in future with as few alterations as possible. With the possibility of grade reductions, the elimination of grade crossings and the application of interlocking, the use of 79-in. wheels will probably be necessary in future, therefore it is desirable to provide for the change.

PROPOSED STANDARD LOCOMOTIVES.

COMPARISONS.

Design by number	1.	2.	3.	4.	5.	6.	7.
Class	2-8-0	2-8-0	4-6-0	4-6-0	4-6-2	4-4-2	0-6-0
Class by name	Consol.	Consol.	10-wheel	10-wheel	Pacific	Atlantic	6-wheel swi.
Gauge (ft. and ins)	4-8½	4-8½	4-8½	4-8½	4-8½	4-8½	4-8½
Weight on drivers	180,000	160,000	133,200	134,000	136,000	102,000	138,500
Weight on truck	20,000	22,000	43,800	44,000	33,000	42,500	......
Weight on trailer	......	......	......	......	34,000	37,500	......
Weight, total	200,000	182,000	177,000	178,000	203,000	182,000	138,500
Wheel base, driving	17-0	17-0	15-0	15-0	12-4	7-0	11-0
Wheel base, total engine	26-0	25-6	25-8	25-8	32-0	27-5½	11-0
Wheel base, total engine and tend.	59-9	58-3	57-2	57-2	62-2	58-8½	41-9½
Length over all	69-10	68-1	67-4	67-4	71-8	68-8½	57-5½
Cylinders, diameter by stroke	22 x 30	22 x 30	22 x 26	22 x 26	22 x 26	21 x 26	20 x 26
Cylinders, spread	88 ins.	86 ins.	86 ins.	86 ins.	86 ins.	86 ins.	85 ins.
Driving wheels, diameter	57 ins.	63 in.	63 ins.	69 ins.	69 ins.	73 ins.	51 ins.
Driving wheel centers, diameter	50 ins.	56 ins.	56 ins.	62 ins.	62 ins.	66 ins.	44 ins.
Driving wheel centers, material	Cast steel	Cast steel	Cast steel	Cast steel	Cast steel	Cast steel	Cast iron
Driving journals	10 & 9 x 12	9 x 12	9 x 12	9 x 12	9½ & 9 x 12	9½ x 12	9 x 12
Trailing wheels, diameter	......	......	......	......	49 ins.	45 ins.	......
Trailing journals	......	......	......	......	8 x 14	8 x 14	......
Engine truck wheels	33 ins.	33 ins.	30 ins.	33 ins.	33 ins.	36 ins.	......
Engine truck journals	6 x 12	6 x 12	6 x 12	6 x 12	6 x 12	6 x 12	......
Frames, width	4½ ins.	4½ ins.	4½ ins.	4½ ins.	4½ ins.	4½ ins.	4 ins.
Boiler, type	Ex. W. T.	Ex. W. T.	Ex. W. T.	Ex. W. T.	Ex. W. T.	Straight	Straight
Boiler, diameter o. d., first ring	70⅝ ins.	66 ins.	66 ins.	66 ins.	66 ins.	72 ins.	62⅛ ins.
Boiler, pressure	185 lbs.	185 lbs.	185 lbs.	185 lbs.	200 lbs.	185 lbs.	180 lbs.
Fire box, length and width	107⅛ x 67¼	96⅛ x 67¼	96⅛ x 67¼	96⅛ x 67¼	96⅛ x 67¼	96⅛ x 67¼	59⅛ x 67¼
Tubes, number of and diameter	383-2	320-2	331-2	331-2	300-2	320-2	234-2
Tubes, thickness	No. 11.	No. 11.	No. 11.	No. 11.	No. 11.	No. 11.	No. 11.
Tubes, length	15-6	15-10	14-2	14-2	18-7	16-0	15-0
Heating surface, tubes	3,092	2,639	2,441	2,441	2,919	2,667	1,828
Heating surface, firebox	Abt. 174	Abt. 155	Abt. 154	Abt. 154	Abt. 154	Abt. 154	108
Heating surface, total	3,266	2,794	2,595	2,595	3,073	2,821	1,936
Grate surface	50.0	44.89	44.89	44.89	44.89	44.89	27.8
Tractive power	40,000	36,200	31,400	28,680	31,000	24,700	31,200
Factor of adhesion	4.5	4.42	4.24	4.67	4.39	4.14	4.44
Center of boiler, from rail	114	116	111	114	113½	108	107½
Tender frame	Channel	Channel	Channel	Channel	Channel	Channel	Channel
Tender wheel, diameter	33 ins.	33 ins.	33 ins.	36 ins.	36 ins.	36 in.	33 ins.
Tender truck, type	Arch bar	Arch bar	Arch bar	Arch bar	Arch bar	Arch bar	Arch bar
Tender journals	5½ x 10	5½ x 10	5½ x 10	5½ x 10	5½ x 10	5½ x 10	5 x 9
Tank, type	Water btm.	Water btm.	Water btm.	Water btm.	Water btm.	Water btm.	Sloping bk.
Tank, water capacity	7,000 gals.	7,000 gals.	6,000 gals.	6,000 gals.	7,000 gals.	6,000 gals.	4,500 gals.

SIX-WHEEL SWITCHER.—The present Rock Island heavy switching engine has proved satisfactory and suitable for the general conditions. The proposed engine is generally similar in all respects. The following recommendations have been made to apply to all engines:

STANDARD DIMENSIONS RECOMMENDED GENERALLY FOR ALL ENGINES.

DRIVING WHEEL CENTERS.—44-in. diameter, cast iron; 50-in. diameter, cast iron, except main; 56-in. diameter, cast steel; 62-in. diameter, cast steel; 66-in. diameter, cast steel; 72-in. diameter, cast steel.

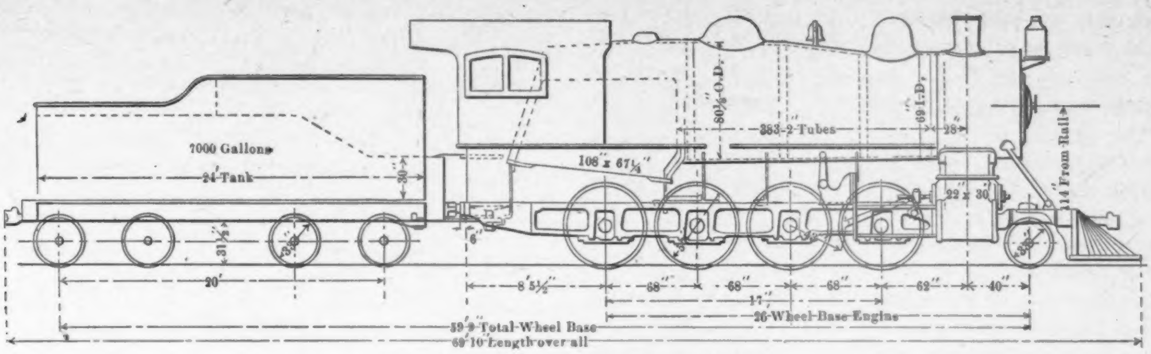
Distance between all driving weel hubs, 55 ins.

TIRES.—All tires Master Mechanics' standard contour and flange 5½ ins. wide. All driving tires 3½ ins. thick.

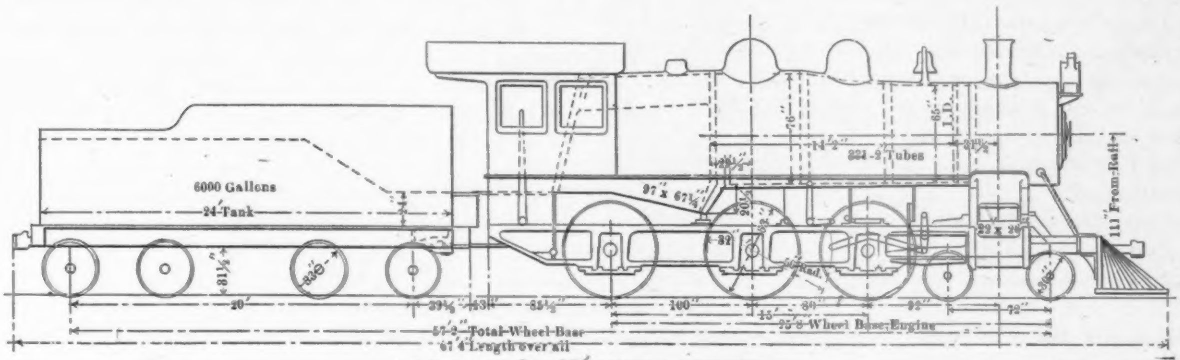
DRIVING AXLES.—Wheel fit ½ in. larger than diameter of journal.

JOURNAL BOXES.—End play made by reducing width of box; 9 x 12 ins., 9½ x 12 ins., 10 x 12 ins. All sizes to be designed for 5-in. width of frame.

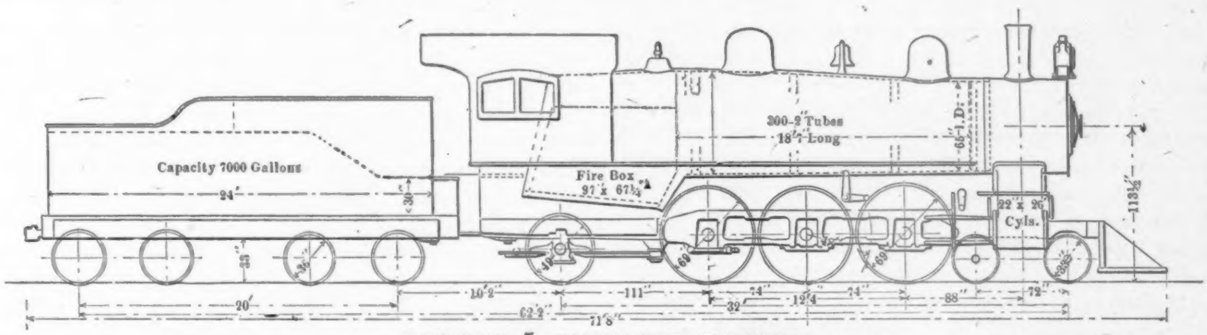
ENGINE TRUCKS.—Distance between hubs of wheels, 52 ins.



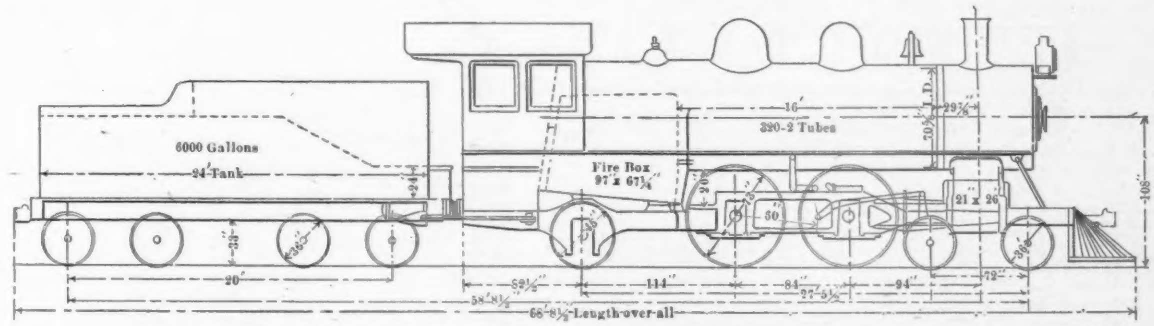
DESIGN NO. 1.—HEAVY CONSOLIDATION.



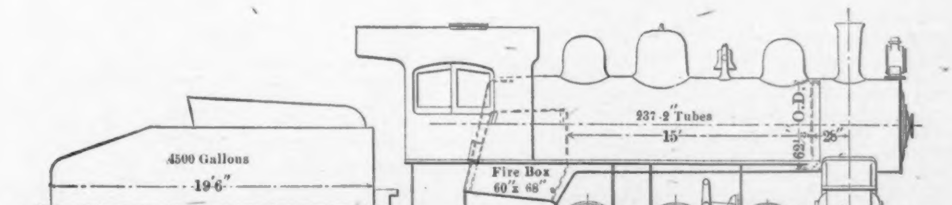
DESIGN NO. 3.—10-WHEEL PASSENGER.



DESIGN NO. 5—PACIFIC TYPE PASSENGER.



DESIGN NO. 6.—ATLANTIC TYPE PASSENGER.



DESIGN NO. 7.—6-WHEEL SWITCHER.

STANDARD DESIGNS ADOPTED BY ROCK ISLAND POWER COMMITTEE.

Nominal outside diameter of wheels, 30 ins., 33 ins. and 36 ins. Actual diameter of centers, 24¼ ins. for 30-in.; 27¼ ins. for 39-in.; 30¼ ins. for 36-in.. Journals, 6 x 12. Wheel fit, ½ in. larger than diameter of journals. Wheel hub, 7 ins. thick.

BOILER.—Radial stay. Staybolts, ⅞-in., spaced 3½-in. centers. Outside rows may be 1 in. Flues, 2 ins. in diameter. Spaced 2⅞ ins. at firebox; 2¾ ins. may be used at front flue sheet, if necessary. Water space, 4½-in. sides, back and front. Width of all fieboxes to be 68 ins., inside ring.

TENDERS.—For switching engines, 4,500 gals.; tank sloping back 19 ft. 6 ins. x 9 ft. 10 ins. For road engines, 6,000 gals., tank 24 ft. x 10 ft.; 7,000 gals., tank 24 ft. x 10 ft. All dimensions inside plates.

TENDER TRUCK AXLES.—M. C. B. standard, with journals 5 x 9 ins. for 4,500 gal. tanks, 5½ ins. x 10 ins. for 6,000 and 7,000-gal. tanks. Center of gravity of the tenders to be kept as low as possible. Consider height of 31½ ins. from top of track to underside of channels for frames having 33-in. and 36-in. wheels.

CABS.—All engines to have steel cabs. Consider present Rock Island practice.

CYLINDERS.—Transverse centers 85 ins. for switchers, 86 ins. for Atlantic, Pacific, medium consolidations, mogul and 10-wheel engines, 88 ins. for heavy consolidations.

FRAMES.—Center to center for frames, 43 ins. for all engines, using 12-in. boxes.

STANDARD TAPERS.

Bolts, 1-16 in 12.
Piston rods for crossheads and piston ends, ¾ in 12.
Wrist pins in crossheads, ¾ in 12.
Eccentric rod pins in link, ¾ in 12.
Mud plugs, 12 threads, ¾ in 12.
Brass fittings screwed in boiler, 12 threads, ¾ in 12.

(To be continued.)

LOCOMOTIVE WIND RESISTANCE.—By applying Mr. Aspinall's formula ($P = 0.003V^2$) Mr. C. F. D. Marshall, in a communication to *The Engineer*, has worked out the resistance due to the air against an area of 16 sq. ft. of an English locomotive front end as follows:

Speed miles per hour.	Pressure in lb. on 16 square feet.	Additional horse-power required.
50	120	16
60	172.8	27.6
70	235.2	43.9
80	307.2	65.5
90	388.8	93.3
100	480	128

WATER SOFTENING.

CONTROL AND RESULTS FROM A CHEMICAL STANDPOINT.

BY G. M. CAMPBELL, P. & L. E. R. R.

(*Continued from page* 52.)

After the weekly reports are received and the samples forwarded to laboratory are tested, a summary report is made out. A sample report for the week ending October 29, 1904, is shown in Fig. 4, size of sheet being 8 x 10½ ins. This report is for record, the daily and weekly reports are for temporary use. Special attention is directed to the column "Average charge, pounds per 1,000 gallons." As explained in the foot note the first figure shows the actual amount used per 1,000 gallons, this, multiplied by the amount of water pumped gives the total amount of soda or lime used. The second figure gives the amount actually used by the attendant for each 1 deg. per 1,000 gals. and the third figure the amount that the table calls for for each 1 deg. The relation between the second and third figures shows whether or not the attendant is attending properly to the charging; a small variation is allowable and is expected, for example, 5 charges may have been put in during one week and water for only 4½ charges put through; the next week the balance would probably be on the other side. The soda rate for all the plants except Whitsett Junction was changed at end of October to 0.100 lbs. per 1 deg. per 1,000 gals. The lime rate is apparently very high at McKees Rocks; this is due to the fact that the acidity is not taken into account, if it was the rate would be the same as the others. The lime rate in the sample report is slightly high at all points. It has

THE PITTSBURGH & LAKE ERIE RAILROAD COMPANY

SUMMARY REPORT OF WATER SOFTENING PLANTS

For week ending Oct. 29" 1904

Plant	Water Gallons Pumped / Hours Pumping	†Average Charge, Lbs. per 1000 Gals. Soda	Lime	Day	Tests: Raw Water Hardness Pumper	Chemist	*Alkalinity Pumper	Chemist	Acidity Pumper	Chemist	Treated Water Hardness Pumper	Chemist	Alkalinity Pumper	Chemist	Causticity Pumper	Chemist
Buena Vista		3.363	1.309	Mon.	25	23	*8	*9½	38	34	3	3	12	11	12½	11
	252,343	.106	.075	Wed.	24	23	*9½	*10½	39	36	3	2	8½	9	10	7
	(14.25)	100	.071	Fri.	23	21	*7	*8	29	26	3	2½	13½	12½	13	13
Groveton		1.409	843	Mon.	26	25	9½	9	5	4	6	6	9	8	11	10
	738,411	.093	067	Wed.	26	25	9½	9	3	2	6	6½	8½	8	9½	9½
	(30.15)	.100	.070	Fri.	24	23	10	9	4	3	6	7	9	8½	10	9½
Hazelton		.809	1.306	Mon.	21	23	14	13	4	3	7½	8½	8	7	9½	6½
	2,269,000	.116	072	Wed.	21	25	14	14	4	3½	7	8½	7½	8	10½	8
	(122)	112	069	Fri.	21	26	14	13½	4	3½	7	9	8½	8	13	7½
McKees Rocks		3.353	2.213	Mon.	42	40½	22	22		6	6	6	4½	5	5	4
	3,340,000	.117	.100	Wed.	42	40½	22	22		6	6	6½	5	5	5	4
	(55.20)	.117	.100	Fri.	42	42	22	22		6	6	6½	5	5	5½	4
New Castle Junction		1.523	644	Mon.	17	16	6	6	2	1	6	5	8½	7½	8½	7½
	738,000	.112	.076	Wed.	17	16	7	7½	2	2	6	6	8½	8	9	8
	(36.45)	.109	.072	Fri.	17	16	6	6	2	1	6	5½	9½	9	10	9
Pittsburgh		2.558	.779	Mon.	24	22	*.3	N	9	8½	5½	5	7	7	7	7
	708,750	.114	.067	Wed.	21	22	N	N	11½	10	4½	5	8	8½	6	6
	(44.55)	.105	.071	Fri.	27	25	*7	*6	13	12	7	6½	6½	7	3	3½
Rock Point		.985	434	Mon.	17	20	6	7	2	1½	6	6	5½	6	6½	6
	526,666	.088	064	Wed.	17	20	6	7½	2	1	6	7	5½	6½	7	6½
	(26.50)	.100	.071	Fri.	17	19	6	7	2	1½	6	6½	6	6½	7	6½
Stobo		.483	.511	Mon.	8½	8½	3	3½	5	5	4	3½	6½	6	11½	9
	740,000	086	.062	Wed.	8½	8½	3	3½	6	4	4½	4	6½	6	9	8½
	(37)	.097	.069	Fri	9	8½	3	4	6	3½	4	4	6½	6½	10½	9
Whitsett Junction		669	1.232	Mon.	23½	25	16	15	2	3½	7	6½	7	6½	9	6½
	236,548	.088	067	Wed.	24	25	16	15	2½	3½	7	7	7	6½	9	6½
	(29)	.083	072	Fri.	24	26	16	15	2½	3½	7½	7½	7½	6½	9½	6½
Williams's		2.651	1 109	Mon.	24	24	1	1	12	11½	4	3	7½	6½	10½	10
	387,836	.108	077	Wed.	26	24	*1	*1	15	14½	6		4		4	
	(35)	.100	072	Fri.	26	24	*1	*1	15	13	6	6	4	3	3½	3
Total	10,844,554															

* When Raw Water is Acid to Methylorange, it is marked with an asterisk (*).
† In Soda and Lime columns figures are: 1st, amount charged: 2d, amount charged per 1°; 3d, amount that should have been charged per 1°.
REMARKS:

E CALVERT
Chemist.

A. M. Campbell

FIG. 4.—SUMMARY REPORT SHEET.

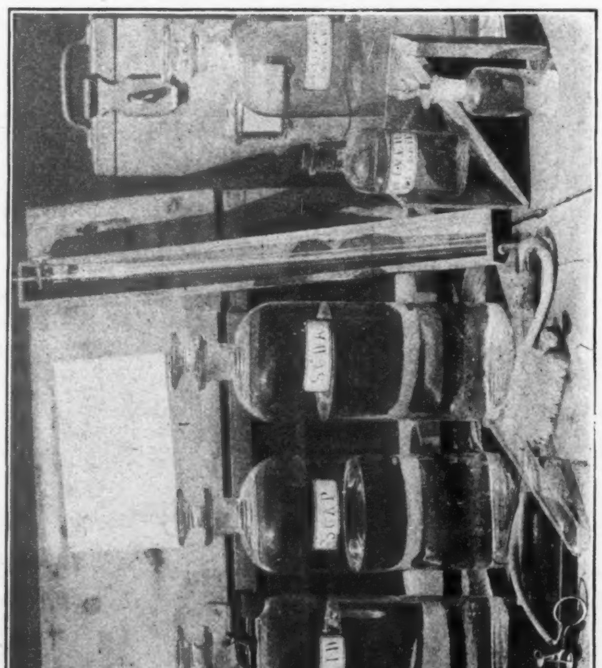


FIG. 5.—TRAVELING CASE WITH TESTING OUTFIT AND CHEMICAL SUPPLIES.

since been reduced to about 0.056 lbs. per 1 deg. per 1,000 gals., which is nearly the minimum allowable with 85 per cent. lime. The soda rate may also be somewhat reduced, perhaps down to about 0.096 lbs. per 1 deg. per 1,000 gals. The figures for hardness, etc., under word "Pumper" are from the weekly report sheets, those under "Chemist" are obtained from the tests of samples shipped to the laboratory. A certain variation is expected in the raw water, owing to the matter in suspension in the sample tested at the softener, which has settled out in the sample sent to the laboratory. The "Acidity" which partly or wholly represents free carbonic acid is, as might be expected, almost uniformly lower in the laboratory sample. A glance at this summary report conveys a very comprehensive idea of the general working of all the plants; on it are based all changes in treatment, censure or praise of attendant, etc.

Chemical supplies for the various plants are forwarded at regular intervals in a special case which contains a complete testing outfit and a supply of all chemicals. The attendant upon receipt of the case takes out what material he requires to replace broken material and puts into the case the broken parts. To renew his supply of chemicals he takes the full bottles out of the traveling case and retains bottle and all; he puts back in the case the old bottles with the balance of the chemicals they contain. In this way every plant is kept supplied with fresh chemical solutions accurately standardized, and there is no danger of the solutions ever being poured into the wrong bottles or otherwise becoming inaccurate. This traveling case is the middle one in Fig. 3. The apparatus carried in it and the case lying on its side are shown in Fig. 5; size of case is 21½ x 14 x 9 ins. The left hand case in Fig. 3 is for distilled water, which is sent out oftener than the other solutions.

By means of the summary report and the traveling supply cases, the quality of the water turned out, the condition of the testing outfit and the general operation of the plant are known with such certainty that it frequently happens that some of the plants are not visited for months at a time. The system of control as outlined may appear at first glance to be intricate, difficult to follow and costly in operation, but the reverse of this is the case; its workings must indeed be smooth and accurate when such excellent results are obtained with a very minimum of personal inspection. The system of control is almost automatic in its operation and works with a precision that is remarkable when it is considered that nearly all the work is done by unskilled men who have absolutely no idea of what chemistry is, and yet who work with a minuteness and accuracy of observation that is hard to surpass; many of them give results differing from the laboratory by not more than ½ deg. or 1 part in 200,000. In the light of such results as have been obtained on the Pittsburgh & Lake Erie Railroad, it is safe to say that with a machine which is fairly accurate in its operation, accurate and definite chemical results can be obtained with any water by any man of ordinary intelligence without the assistance of a chemist except for the occasional analysis of the treated water simply as a check to make certain that results thought to be obtained are actually obtained.

Very much has been written concerning water treatment and the proper chemicals to use; all authorities agree that for general purposes the only available chemicals are dehydrated sodium carbonate, usually known as soda ash, and calcium oxide, usually known as unslaked lime; these are used in preference to all others simply because they are the cheapest chemicals which will do the work. If soda ash and lime are used, a fixed and definite amount is required to change a water from one condition to another and this amount is absolutely independent of the machine. It is frequently stated that a smaller amount than is required by the chemical equations will answer; this statement is entirely incorrect. At the same time, all classes of machines are not equally efficient, there is often a great waste of lime in continuous plants due to the lime being run to sewer before it is all used, there is sometimes much waste in soda also, owing to the irregular action of the proportioning devices and a consequent frequent surplus of soda. With a machine, working with good commercial accuracy, the chemical cost of water treating depends altogether on the initial quantity of the water and the price of soda ash and lime. Soda ash at present, December, 1904, costs f. o. b. Pittsburg, 0.78 cents per lb., and lime 0.42 cents, allowing an average of 185 lbs. of lime per barrel. The cost of treating any water is found by obtaining from the summary report sheet the amount of lime and soda used per 1,000 gals. and multiplying by the values above. The costs per 1,000 gals for the 10 plants for the sample week given are: Buena Vista, 3.17 cents; Groveton, 1.45 cents; Haselton, 1.18 cents; McKees Rocks, 2.76 cents; New Castle Junction, 1.46 cents; Pittsburg, 2.32 cents; Rock Point, 0.95 cents; Stobo, 0.58 cents; Whitsett Junction, 1.04 cents; Williamsburg, 2.53 cents. This gives a weighted average for all plants of 1.85 cents per 1,000 gals. The waste at these plants does not at present (December) exceed 3 per cent., it will later be still further reduced. To obtain the total cost per 1,000 gals., the cost for pumping and for attendance should be added; these costs will vary according to the height the water has to be pumped and the number of gallons pumped, neither item being appreciably increased with a continuous process by reason of the softening. At McKees Rocks, where water is pumped by a motor-driven turbine pump, the cost for pumping averages about 0.4 cents, and the cost for attendance about 0.4 cents, or a total of 0.8 cents per 1,000 gals. The cost for treating the well water at that point is rather high. When the river water is used it is expected that the average cost for treating will not exceed 0.7 cents, so that the total cost will then be about 1.5 cents per 1,000 gals., a very cheap water.

The general results from a chemical standpoint may be judged from the following figures compiled from the weekly summary reports for the two worst months, September and October, of the present year. Figures are the weighted average each week for the output of all 10 softeners:

Week ending	Raw Water. Hardness.	Treated Water Hardness.	Treated Water Alkalinity.	Treated Water Causticity.
Sept. 3, 1904	24.20	6.08	5.96	5.98
" 10, "	25.60	5.57	6.50	6.25
" 17, "	26.36	6.06	6.54	6.94
" 24, "	25.12	6.13	6.49	6.31
Oct. 1, "	26.05	5.45	6.23	6.96
" 8, "	25.62	5.26	6.33	6.98
" 15, "	26.64	6.54	6.87	6.50
" 22, "	26.38	5.92	6.18	6.57
" 29, "	27.27	6.03	6.50	6.31

The general average for the two months is: Hardness, 5.89; alkalinity, 6.40; causticity, 6.53. During these two months the total amount of water treated was almost 100,000,000 gals. The maximum variation in the treated water in the weekly averages for hardness, alkalinity or causticity was about 1 deg. or 1 part per 100,000. During these two months limiting variations in hardness of the raw and treated waters were:

	Raw Water. Degrees.	Treated Water. Degrees.
Buena Vista	13 to 44	3 to 9½
Groveton	19 to 25	4½ to 7½
Haselton	13 to 26	5 to 9½
McKees Rocks	40 to 42	4½ to 8
New Castle Junction	11 to 18	5 to 8
Pittsburg	17 to 35	3 to 7½
Rock Point	14 to 20	5 to 8
Stobo	8½ to 10½	3½ to 5
Whitsett	19 to 26	4½ to 7
Williamsburg	19 to 24	3 to 7½

The maximum hardness of treated water did not usually coincide with maximum hardness of raw water. The high hardness in the treated water was not necessarily scale forming, as that depended on the corresponding alkalinity. The hardness of the treated water may seem somewhat high, as for example 9½ deg. at Buena Vista, but it must be remembered that this was the worst figure obtained during two months when the raw water at times fluctuated violently. It was only occasionally that the hardness of the treated water got above 6½ deg., or about 3.8 grains to the gallon.

From the general averages it would at first sight appear that about 80 per cent. of the scale-forming material was removed. Actually fully or almost 100 per cent. of the scale-forming material is removed, when the hardness of the treated water is equalled or exceeded by the alkalinity and the alkalinity equalled or exceeded by the causticity. Water of the composition of the average for weeks ending September 10, September 24, October 15 or October 29 would form absolutely no

scale; that for weeks ending September 17, October 1, October 8 or October 22 might or might not form scale, if scale was formed the amount would be extremely small; that for September 3 would theoretically form a minute amount in boilers under high steam pressure. The 6 deg. of hardness left in the water forms a non-adhesive precipitate which is washed out or blown out as sludge. From an examination of the sample report for week ending October 29, the following information may be obtained. During the week, in treating the 10,044,554 gals., there were neutralized or removed about 250 lbs. of sulphuric acid, about 2,500 lbs. of carbonic acid gas, about 17,000 lbs. of hard scale-forming matter, such as sulphate of lime and magnesia, and about 4,700 lbs. of soft scale-forming matter, such as carbonates of lime and magnesia, and also much mud (not shown on report). There remained in the treated water about 5,000 lbs. of carbonates of lime and magnesia which would not form scale in the absence of the sulphates of lime and magnesia and which would be precipitated as sludge. About 20,000 lbs. of sodium sulphate, a completely soluble non-scale-forming substance were formed in the water, besides small amounts of common salt. The chemicals used were 16,639 lbs. of soda and 13,662 lbs. of lime.

Water has been and is now being treated on the Pittsburg & Lake Erie Railroad in such a way that it will form absolutely no scale, and no deposit in injector pipes or pumps. During the present year (1904) not one locomotive has been reported with clogged injectors. As an example of the working of the water, attention may be directed to the six B. & W. 250-h.p. water tube stationary boilers, working at 150 lbs. pressure, in the McKees Rocks power house. In the end of the year 1903, when from reasons chiefly of policy, the water was not fully treated, hardness being from 9 to 10 and alkalinity from 5 to 6, 56 boiler tubes were burnt out, due to the presence of scale, despite the fact that the boilers were in service only 10 days at a stretch and that the tubes were thoroughly cleaned out each time with a turbine flue cleaner. After the water was fully treated, this trouble absolutely ceased, and all work on the boilers was discontinued. The boilers are now run from 5 to 6 weeks and remain entirely free from scale. At the power plant at Pittsburg similar boilers were in use for about 3 years before the softener was installed, and had accumulated a considerable thickness of scale; this scale was entirely removed by the treated water and now the boilers run perfectly clean. In the locomotives troubles from corrosion have entirely ceased; no scale whatever is formed and much of the old scale is removed; these remarks apply of course only to such locomotives as get only treated water. There is some trouble from "foaming," or more properly, "priming," but considering the extremely bad condition of the raw waters and the consequent large amount of soluble salts left in the water the number of engine failures due to priming is very small. The trouble is kept at a minimum by means of the Raymer hot water washing-out appliance (AMERICAN ENGINEER AND RAILROAD JOURNAL, November, 1904), by means of which the locomotive has its water frequently changed, without any delay or racking of the boiler, due to contraction and expansion. The point where a water begins to prime is a very indefinite one, some locomotives have been reported "foaming" when the soluble salts did not exceed 75 grains to the gallon, others on exactly similar service have been satisfactory with 250 grains to the gallon. In the stationary boilers at McKees Rocks, where the boilers are free from scale, the soluble salts have reached 600 grains to the gallon with no "priming" whatever. There is also some trouble due to leaky flues and staybolts, but small when compared with troubles on other roads in the Pittsburg district. The water is absolutely non-corrosive and the present troubles due to leakage should not be assigned to the water unless it is that the purified water removes the scale which would otherwise help to close up openings. The troubles arise mostly from mechanical causes, not chemical, and the question will be solved along that line. A better design of fireboxes, a better system of firing, protection to the flue sheet from draughts of cold air, more care in cooling down boilers and more care in use of injectors, will greatly tend to remedy this trouble. Data on engine failures due to foaming and leaking will probably be published as soon as sufficient have been obtained.

(To be continued.)

HYDRAULIC SHEARING PRESS FOR COUPLER POCKETS.

To move old couplers to the shops or to cut out the pocket rivets by hand are expensive operations. The machine illustrated was designed by Mr. R. D. Fildes, machine shop foreman of the Lake Shore & Michigan Southern at Englewood, Ill., so that the power could be taken to the work and the pocket rivets sheared off as rapidly as the couplers may be handled by the attendants. These machines have been in use at Englewood, Collinwood, Toledo and Ashtabula for three years, and they are available wherever an air pipe can be taken. At these points they are located at the scrap bins. Their work is quicker than that of a hammer, and the rivet heads do not fly. These machines are also used as forging presses for a variety of heavy work on car material.

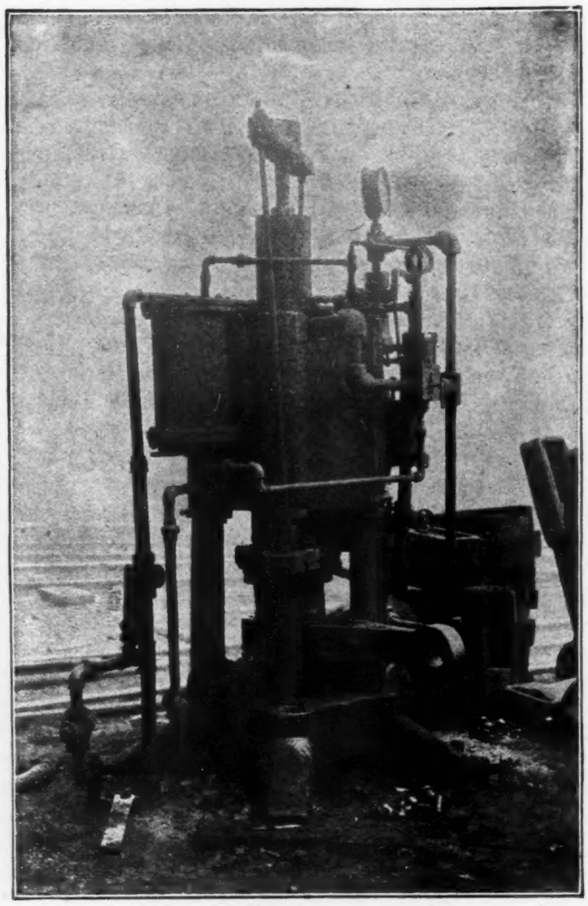


FIG. 1.

A photographic view is shown in Fig. 1, illustrating a broken coupler shank, with the pocket attached. The machine is heavy and does not break down; neither does it require skilled labor. At the right, in Fig. 2, an air cylinder is shown. This receives air from the throttle, through a self-actuated, reciprocating valve, and the extended piston rod of the air cylinder operates two hydraulic pumps above and below the air cylinder. These pumps give a pressure of 200 tons to the press plunger with an air pressure of 100 lbs., this being sufficient to shear off two $1\frac{1}{8}$-in. rivets in two places, and do it quickly. By means of the three-way cock, shown at the left in Fig. 3, the main plunger cylinder is filled with oil from the reservoir shown at the left in Fig. 2, thus forcing the main plunger quickly to its work with the air pipe pressure only. Another movement of this valve starts the air pump and increases the pressure for the cutting portion of the stroke. The return stroke is made rapidly by means of direct air pressure through the pull-back cylinder on top of

the machine. The pull-back piston raises the main hydraulic plunger by means of the yoke and rods.

In operation, thin blocks are placed at the sides of the housings in Fig. 2. The pocket rests on these, and a square block is placed on top of the coupler shank. The plunger pushes the coupler down through the pocket, shearing off the rivets. The operation of the threeway cock in closing the air supply to the pump applies air to the lifting cylinder, and lifts the plunger for its next stroke.

These machines are adapted to a large variety of work in the blacksmith shop, as well as to the shearing of pocket rivets.

INTERESTING USE OF COMPRESSED AIR.—The explosion in one of the turrets of the United States battleship "Missouri," which occurred with fatal results last Spring, is now being guarded against by the use of compressed air. The explosion

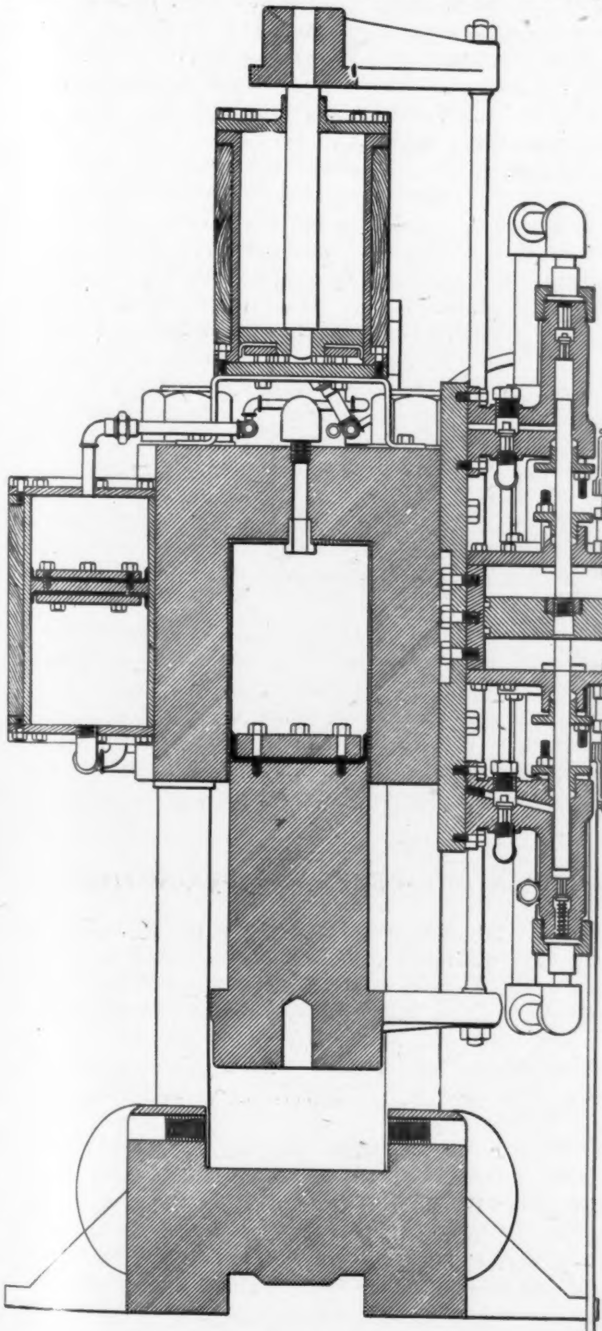


FIG. 2.

was supposed to have been due to the presence of sparks in the gun after firing, these sparks having ignited the charge of explosive which was placed in the gun for the next shot. The explosion communicated to the magazine below the turret, causing fatal results there, as well as in the turret itself. Compressed air from an electrically driven blower was used to clear the gun after each shot; now, however, the pressure is increased to 100 lbs. per sq. in., which is believed sufficient to insure against recurrence of the accident.

LINSEED OIL PAINTS.—It would perhaps be too strong a statement without limitation, but we cannot help feeling that our experiments seem to indicate that it is going to be difficult, not to say impossible, to make a perfectly water-resistant protective coating out of a material which consists largely of linseed oil. Substances brought forward as protective coatings which dry by evaporation of the solvent, seem to offer much more prospect of success.—*Dr. C. B. Dudley, before American Society for Testing Materials.*

LARGE GENERATING STATION.—The condensing equipment for the new generating station of the Edison Illuminating Company, South Boston, has sufficient capacity to condense 153,000 lbs. of steam per hour with water at the summer temperature of 70 deg. F.

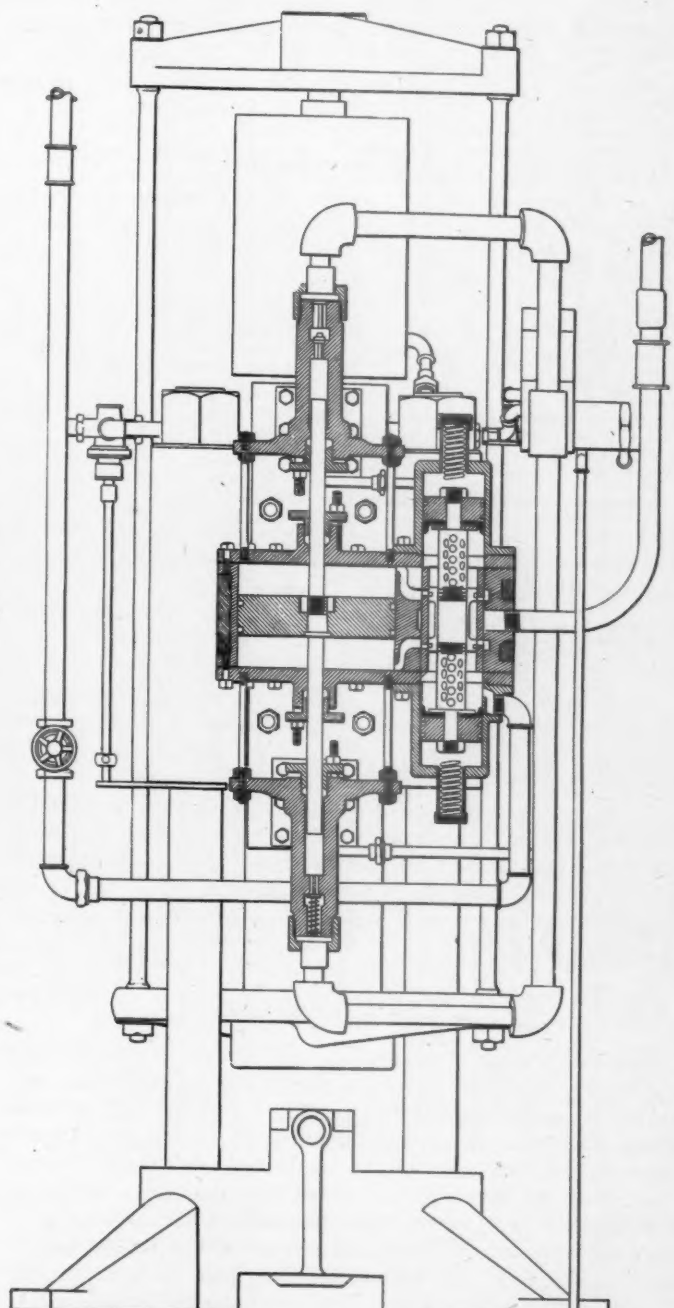


FIG. 3.

The Society of Engineers of Eastern New York met in Troy February 15. The paper of the evening was entitled "Modern Ordnance," by Captain O. D. Horney of the Ordnance Department, U. S. A., at Watervliet Arsenal. The total membership is now 175. The following officers were elected: Professor O. H. Landreth, president; Captain Odus C. Horney, vice-president; W. I. Slichter, treasurer; J. A. Kinhead, member Finance Committee; F. E. Crane, member Executive Committee; Albert E. Cluett, secretary.

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Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

We cordially invite our many friends attenuing the conventions at Manhattan Beach in June to make use of our offices. Telegrams and mail addressed in our care will receive careful attention.

In this issue an account is given of the productive improvements at the Chicago shops of the Chicago & Northwestern Railway. This remarkable record from an old shop sets a difficult pace for the superintendents of the newer shops.

It is one thing to build a new shop plant with good buildings and cranes. It is another thing to supply the necessary machines and other equipment. Most of the recent shop plants are well supplied with buildings and tools, but the remaining requisite is an efficient organization and effective shop management.

ELECTRIC TRACTION.

In a valuable paper on developments in electric traction read by Mr. W. B. Potter before the New York Railroad Club, and which is partly reproduced on another page of this journal, some interesting figures are given concerning the comparative cost of operating railroads by steam and electricity. In the discussion Mr. W. J. Wilgus stated that the cost of electrifying the New York Central suburban service will be about one-quarter of the expenditure to secure the full value and benefit of electrification. He also called attention to the necessity of abolishing grade crossings. Mr. B. G. Lamme advocated the use of alternating current motors and higher motor voltages as the next logical step in improvement. Mr. Bion J. Arnold also advocated the alternating current system and stated that in his opinion our main steam railways will eventually be operated by electricity, first for passenger service and finally for freight service. The equipping of the suburban service with electricity will induce some road which has sufficient density of traffic to equip its passenger service electrically between trunk line points. Then the other roads will soon have to furnish electric passenger service between competing points, and after their passenger service becomes equipped, even though it cost more to operate by electricity, their entire service will eventually thus be operated, and the increased revenues due to different and speedier methods of handling freight will warrant the increased investment.

IMPROVED WATER SERVICE FOR LOCOMOTIVES.

There is no stronger contrast between modern and ancient practice in railroad operation than that shown in locomotive water service. Formerly delays at stations in order to fill locomotive tenders from very small water cranes, were taken as a matter of course and on many railroads such delays continue. If one operation connected with the handling of a train at a station stop is sluggish, other operations at that station are likely to be slow in sympathy. Many progressive railroads, particularly in the West, have appreciated the importance of suitable water service and have equipped main lines with large cranes with rapid delivery. The latest practice changes the taking of water from the slowest to the swiftest work done in a station stop and much can be gained through the influence of this upon other work which must be done at a station.

Within a year or two 151 stations on a number of roads have been equipped with new water service, which includes 14-in. pipe connections for supplying water from the tanks to the cranes, combined with 12-in. crane spouts for delivering the water to the tenders. From these cranes 8,000 gals. of water is delivered per minute, and this is quite impressive when considered in weight, which means about 33 tons of water delivered in 60 seconds. There is not the slightest difficulty in handling the water at this rate as far as the water fixtures are concerned. This enormous stream is easily started and stopped, but there has been some difficulty in getting the air out of the tanks to admit such a flood of water. Larger manholes in the tanks are recommended and it even seems advisable to use an opening 3 ft. in width, extending clear across the tank. This will not only provide ample room for the escaping air, but will give additional leeway of 2 or 3 ft. in the range of the water crane.

Doubtless these fixtures cost somewhat more than the small and inadequate ones, but this would seem to be an excellent investment in view of the possibilities of reducing the time of important trains at station stops, which must be made up when running and at great expense of fuel and physical strength of the firemen. A campaign in this direction of improvement has been carried on quietly in the West with most satisfactory results.

AUTOMATIC STOKERS FOR LOCOMOTIVES.

Those who know most about locomotive stokers believe that they save coal. Certainly they save manual labor, and if they will save no fuel whatever, the mere mechanical handling of the fuel places them before railroads in an exceedingly attractive and promising light. Experience thus far has been confined to but one type of stoker (AMERICAN ENGINEER, July, 1904, page 284), and it has demonstrated certain facts sufficiently definitely.

This stoker is an attachment to, and not a part of, the locomotive. It merely throws the coal into the firebox, but does not relieve the fireman from carrying the coal from the tender. It has been mounted upon wheels, to be easily put out of the way, and when in service it monopolizes the only access for the fireman to the fire. It has definitely shown the possibility of throwing and properly spreading 17,100 lbs. of coal per hour over an area larger than can ever be used in a firebox. It works all day and does not tire in either hot or cold weather. As Dr. Goss puts it—the automatic stoker for locomotives is an automatic shoveler. But it needs to be more than that in order to meet the present needs and expectations. It must transport the coal from the tender to the grate, and it must be arranged in such a way as to permit the fireman to closely watch the fire and give the occasional scoopful by hand, which is needed to provide for variations in the burning of the fire. A device which is merely an at-

tachment, with provision for stowing it out of the way when out of order, cannot fill the requirements demanded of the locomotive stoker. It must be installed as a permanent part of the locomotive, and so regarded. This stoker is now being re-designed, and it is to be hoped that these features will be included. If they are included, the device may be expected to become an important influence on locomotive operation and design.

Incidental advantages of the stoker are a relief from smoke, an increase in the life of the firebox because of keeping the firedoor closed, a more uniform steam pressure, and the possibility of successful use of inferior grades of coal. The chief advantage, however, lies in the large capacity for throwing coal.

Eventually, the stoker may influence the design of fireboxes. Mr. Henderson believes that fireboxes as long as 14 ft. may be successfully used, as the stoker easily covers even a greater length than that. He suggests the return to the 4—6—0 type for 6-coupled engines. This may or may not be done, but the matter of greatest importance just now is to get the stoker into shape to carry the coal from the tender to the fire, and do it in such a way as to permit of supplementing its automatic operation by manual skill, to provide for the conditions which cannot be met by means of a brainless machine. It is difficult to see how the device can be successful without these two essentials. With them the present stoker ought to be completely successful in the hands of intelligent men.

IMPRESSIONS OF FOREIGN RAILROAD PRACTICE.

EDITORIAL CORRESPONDENCE.

PARIS.

The efficiency of locomotive engineers and firemen both in England and in France impressed me, and this led to as careful a study of conditions as time permitted. As a result I have a collection of information which may be suggestive to American managements, showing how these foreign roads bring engineers and firemen to view the coal pile on the tender as if they had paid for it and had it in their own cellars.

Coal premiums constitute the secret. These receive very careful attention from the highest officials. They add to the clerical service, but the returns must be beyond all proportion to the trouble and the cost. The enginemen are not believed to be more intelligent than ours, but these premiums bring them into partnership with the company in the coal pile and they use their wits to save coal. Locomotive engineers over here do not leave the starting valves of Vanclain compounds open throughout an entire run, as some of ours do, because they do not care.

A French engineer cannot afford to waste coal, neither can he afford to be late or to set out cars. There may be reasons why the French premium plan will not work well on American roads, but some of the schemes used in England may be applicable. I shall be glad to place these before the readers if they signify an interest in them.

Through the courtesy of one of the leading motive power officials in France I received a copy of the service circular relating to the premiums paid engineers and firemen. This has been translated and is commended to the attention of those who are concerned in the administration of our railroads. I was not asked to withhold the name of the road, but courtesy demands this. The circular is as follows:

PREMIUMS ON ECONOMY OF FUEL FOR ENGINEERS.

The quantity of fuel allowed for hauling a given number of cars is fixed according to the section of the system traveled and according to the season of the year, by tables given out by the general superintendent of motor power. These tables comprise different allowances for winter and summer service. Summer service covers a period of seven months, April to October. Winter service covers five months, November to March. The premium, set per 1,000 kilogrammes of fuel saved (termed co-efficient), is fixed by the general superintendent of motive power.

The allowance per engine, running light, is fixed at 5 kilogrammes for engines (specifying engine numbers), and at 7 kilogrammes for engines (specifiying numbers). This allowance shall be 8 kilogrammes per kilometre for engines with 6 driving wheels and 10 kilogrammes per kilometre for engines with 8 driving wheels. Above allowances include starting of fire and maintaining same while waiting.

Allowance of fuel for engines, type 1775 (giving number and train) are fixed as follows from January 23, 1903:

Nature of Service.	Limited Number of Loaded Cars.	Allowance per Mile.	Allowance per Loaded Car in Excess.
South Express, summer..	10	32.73 lbs.	1.062 lbs.
South Express, winter....	10	34.50 lbs.	1.238 lbs.

The coefficient is fixed to $1.60 per gross ton.

Allowance of fuel for engines, type 1901 of the Depot of Toulouse, are fixed as follows from August 1, 1903:

Nature of Service.	Limited Number of Loaded Cars.	Allowance per Mile.	Allowance per Loaded Car in Excess.
Passenger train, summer.	8	29.78 lbs.	1.77 lbs.
Passenger train, winter..	8	31.52 lbs.	1.95 lbs.

The coefficient is fixed at $1.60 per gross ton.

Further, there is allowed for reserve service from 17 to 20 kilogrammes for engines specified in the circular by numbers. Whenever a train requires two engines the allowance for each engineer is calculated on the supposition that each engine hauls one-half of the train. Whenever a train, not requiring two locomotives, is nevertheless drawn by two engines under steam, the second locomotive is considered as running light. Road engines doing switching at stations are allowed 15 kilogrammes of coal per kilometre of switching. Locomotives destined to switching stations, have allowances fixed by the general superintendent of motive power.

Whenever a passenger train is behind time from any cause, for which the engineer is not responsible, and he makes up time during the run, he is granted a special premium for each minute made up during the run. This premium is determined for each train by the general superintendent of motive power, without exceeding the one given in the following table:

Kind of trains.	Maximum premium per made-up minute.
Fast and express	0 fr. 30
Through and local	0 fr. 20
Mixed	0 fr. 10
Freight-carrying passengers	0 fr. 10

A notice stating, for each train, the value of premiums per made-up minute is sent to the crew.

PREMIUMS FOR ECONOMY IN LUBRICATION.—Allowances of lubricating material are also fixed in a supplement to the circular.

PREMIUMS FOR RUNS.—Engineers are given premiums for runs, independent of the premiums for economy. The premium is calculated on the following bases:

Engines (engines specified by numbers)...	f. 0050 per kilom. up to 5,000 kilometres f. 0075 per kilom. above 5,000 kilometres
Engines (engines specified by numbers)...	f. 0075 per kilom. up to 4,000 kilometres f. 0100 per kilom. above 4,000 kilometres
Engines (engines specified by numbers) (trains of all kinds)	f. 0075 per kilom. up to 3,500 kilometres f. 0100 per kilom. above 3,500 kilometres
Engines (engines specified by numbers)...	f. 0125 per kilom. up to 2,500 kilometres f. 0200 per kilom. above 2,500 kilometres
Shifters............	f. 020 per kilom. for any run whatever.

For engines doing shifting service one hour's shifting is counted as 6 kilometres.

FINES FOR EXCESS IN CONSUMPTION.—For consumption of fuel exceeding the stipulated allowance in the special tables a fine is imposed equal to the stated figure for premium of economy. All excess of grease consumption causes a fine of 0fr. 50c. per kilogramme. These fines are most rigorously enforced unless the engineer proves that the excess in consumption has been independent of his will.

FINES FOR IRREGULAR RUNS.—Special fines, according to the seriousness of the case, are imposed when it is proven that a delay of any kind is caused by unintelligent waste of fuel or grease. Apart from these circumstances a delay of one minute is not attributed to the fault of the engineer running a passenger train, mixed train or a freight train carrying passengers. An engineer arriving, through his own fault, more than a minute behind time, suffers a fine of 0fr. 50c. per minute behind time, counted from the stipulated limit on. A delay may be discounted not only upon the train's arrival at terminal point, but also at meeting points with other trains, as well as turnouts and junctions, and in that case the fines may accumulate. A delay of 10 minutes is tolerated with freight trains. If the engineer, through his fault, arrives more than ten minutes behind time he suffers a fine of 0fr. 23c. per minute's delay counting from the allowed limit on. A delay

may be discounted, not only upon the train's arrival at terminal point; but also at meeting points with other trains, as well as at turnounts and junctions, and in that case the fines may accumulate. Every accident to the engine, from whatever cause, delaying the train more than 15 minutes, involves retaining of the engineer's premiums to the following amounts:

10 francs if the engineer runs a passenger train.
8 francs if the engineer runs a mixed train.
6 francs if the engineer runs a freight train.

These deductions occur likewise each time engineers find themselves, either through incompetence, or damage to the locomotive, obliged to put off cars, to refuse to complete their load, to require help or to have their engine replaced.

Reserve Engineers and Engineers of Work Trains.—Reserve engineers and those running work trains receive for each day of active service an average premium equal to the average premium of engineers (of the same class to which they belong) running scheduled trains. However, this premium shall never exceed 75 francs per month.

Firemen.

Road firemen are entitled to a premium equal to one-half of the net premium earned by each engineer for whom they fired, in proportion to the number of kilometres made with each of them. Firemen around warehouses and stations receive for each day of active service an average premium equal to the average premium of engineers in their district; but this premium can never exceed 2 fr. 50c. per day. Reserve firemen receive for each day of active service an average premium equal to the average premium of the firemen of the group to which they belong. If, however, they do shifting work in stations, for which work allowances have been established, they receive a premium equal to one-half of the premium which would result from the application of these allowances to reserve engineers.

General Arrangements.

The accounting of premiums is made at the end of each month by means of sheets which are taken daily from the reports made out by the conductors and signed by the engineers for each train: In their report of runs. In their report of shifting.

In the accounting of hauled cars, all cars are reduced to loaded ones, fractions omitted. Every car of a passenger train is counted as a loaded car. In figuring freight trains two empty cars are counted as one loaded car.

Allowances for Grease.

The locomotives are classified according to their size and service, and allowances specified for each, varying from 0.071 lb. to 0.178 lb. per mile. Switching engines are also classified and allowances of from 0.089 to 0.124 lb. per mile provided. The latter figure is made specially to cover switching service in some coal mines. The premium for saving grease is fixed at 2¼ cents per lb. saved.

Note.—These premiums are most carefully provided for and consciously administered. They are also very effective.

G. M. B.

(To be continued.)

Valve Motion and Locomotive Failures.—The speaker is of the opinion that more engine failures, so far as relates to machinery, are caused to-day by improper distribution of steam than by anything else, and my faith is strengthened in this opinion through the fact that we have a locomotive on this road that has a different valve motion from the other engines. It is designed on the Corliss principle, a rocking valve. This engine has been out of the shops for about 13 months, and has made, to date, about 96,000 miles, and has not had an engine failure due to machinery since it has been out of the shops, and the mileage made to 1-16 in. wear of tire is a little better than twice as much as is made by other engines of the same class, as well as being in the same kind of service, the only exception being the valve motion. This is not only true of the tire, but it is true of the entire valve motion, including the pins that operate the valves. After 13 months of service the tool marks are not worn out on the eccentrics and links, rocker boxes, etc., and in looking for the cause of this we find that it is due to a more even distribution of steam. This appears to open up a grand opportunity for decreasing engine failures as well as reducing the cost of maintenance.—*Robert Quayle, before students of Ames College.*

CORRESPONDENCE.

WHAT CAN A FIREMAN SAVE.

To the Editor:

Referring to the article on page 53 of your February number, under the head of "What Can a Fireman Save?" we believe the lack of education among engineers, firemen and shop men, as well as other branches of railroad employes in their duties, is due largely to the poor service rendered, and do not believe the increase in severity of discipline will help matters at all, but only tend to make them a great deal worse.

It is hard to say just who the best men are until they have had a fair training in their line of duty so as to determine by development.

In asking men to do any line of work that requires some knowledge it has been fully demonstrated that something more than brute strength is required.

We do not believe that education has been an expensive luxury in the past, but has resulted in good service and a great saving for railroad companies.

T. E. Adams.

WATER SOFTENING.

To the Editor:

Permit me to offer the following criticism regarding the very carefully prepared "Instructions to Pump-men" which appeared on page 51 of your February number. This method of going about to define treatment belongs to the same category as would the furnishing of each engineer with a kit of watchmaker's tools, and written instructions for their use, and then requiring him to keep his watch accurate. The ordinary workman employed in pumping duty is no more qualified to carry out chemical tests than the average engineer is competent to take his watch to pieces and reassemble the parts. The most carefully written set of rules for guidance will prove as inadequate in one case as in the other. We expect too much from a pump-hand when we expect this of him; and not only so, but we make too great demands upon his time. To keep in proper order the set of instruments and the solutions requisite for these tests, and to make the tests with due attention to accuracy, demands more time than the workman has to spare from his routine duty. Nor is such attention on the part of the pumper necessary. It may be well to send daily samples to some central laboratory, in order that we may be sure that everything is going properly: just as we wire the correct time, at some fixed moment, to all stations on the line, in order to check the accuracy of the clocks and watches of the employes. But, when a clock or a watch shows itself in need of repair, we have it attended to by a qualified watchmaker instead of sending instructions to the station agent or other employe.

The periodical changes which characterize all water supplies are never of such a cataclysmic kind as cannot be provided for by properly qualified men; and any source of supply so small and so exposed as to be liable to sudden and violent change—as by the waste water from a chemical factory, a dye-works, or other pollution—is so acutely dangerous that it must be rejected as boiler supply at all cost. Since the crux of this difficulty lies in the lack of necessary skill on the part of the workman, it is of no particular importance whether the tests furnished him are of a satisfactory kind or not; just as, since the ordinary locomotive engineer is bound to spoil his watch if he begins tinkering with it, so it is immaterial whether you give him a good or a bad set of tools to do it with.

It may, however, be permitted, as a matter of interest, to make a few remarks on the value of the soap test in determining the hardness of water. This test is no longer in use in any laboratory where accurate work is done. It has as completely gone out of responsible use as has the flint and tinderbox. Just as these last did good work in their day, so we have kindly recollection of the Clark soap test. But, for reasons of its established inexactitude, and because we have discovered elegant and accurate modes of doing what it proposed to do, we are content to relegate it to a place of honor among the gods whom we have ceased to worship. The following quotations from statements by men who have an acknowledged right to express an opinion on chemical subjects will be read with respect:

Otto Hebner, F. I. C., etc. (*The Analyst*, 1883, 77).—Of all methods of which analysts are in the habit of availing themselves in judging of the quality and composition of drinking water, that for the estimation of the hardness, by means of soap solution, is by far the most imperfect. I sincerely hope that the alkalimetric estimation of both descriptions of hardness will speedily supersede

the use of the soap solution, which has no other recommendation than its comparative antiquity.

ALFRED H. ALLEN, F. I. C., F. C. S., etc. (*Jour. Soc. Chem. Indust.*, 1888, 795).—I submit that the time has come when professional chemists should cease to report results obtained by the soap test, and should abandon it in favor of other methods which furnish the information required more accurately, and quite as speedily, as Clark's process.

DAVID HOWARD, Prest. Soc. Chem. Indus., 1886 (*Jour. Soc. Chem. Indust.*, 1888, 802).—What Mr. Allen has said about the soap tests would agree with the experience of a good many of his audience. For my own part, I have given up that test in despair.

PROFESSOR PERCY F. FRANKLAND (Dict. of App. Chem., 1900, Vol. III., p, 984).—In the presence of magnesia salts the results [of the soap test] are always less accurate; and, unless great care is exercised, may become wide of the truth.

R. MELDRUM, F. C. S., etc. (*Chem. News*, 1898, 294).—Soap solution is not a reliable standard for determining the amount of lime present in very weak lime water, as will be seen from the following: * * *

J. C. THRESH ("Examination of Water and Water Supplies." London: J. A. Churchill, 1904, 190).—The futility of attempting to determine the amount of carbonates and sulphates of calcium and magnesium by the soap test is exemplified by the following experimental results: * * *

LEFFMANN AND BEAM ("Examination of Water." London: Kegan, Paul, Trench & Co., 1891).—These authors, in describing methods of determining the hardness of water, make no mention whatever of the soap test.

Opinions of the character here illustrated might be multiplied indefinitely—but these may suffice. It is, of course, very much to be desired that tests sufficiently simple in execution to render them effective in the hands of ordinary laborers, and sufficiently delicate to ensure a high degree of accuracy, should be available. That these conditions are not fulfilled by the tests named need not surprise us, when we stop to think what 5 to 10 grains per gallon really means. Ten grains per (imperial) gallon is only one part in seven thousand. This is a higher degree of accuracy than was expected, or, indeed, attainable, in the average output of work from a well equipped laboratory. Expressed in percentage results, it means accuracy to within one unit, in the second place of decimals.

We are working (in water softening) upon immense volumes, but it does not follow that an extra shovelful or two of the reagent makes no difference, for our solution is a highly attenuated one, a fact which—if proper results are desired—must be kept constantly in mind. If one might be permitted to desecrate Browning's immortal lines by such an application of them, I would quote:

"Oh, the little more, and how much it is;
Oh, the little less, and what worlds away!"

A. McGILL.

EDITOR'S NOTE.—We regret that Mr. McGill's communication was received too late to refer to Mr. Campbell for reply in this issue. On another page of this journal Mr. Campbell presents some interesting data concerning the cost of treating the water and the remarkable results obtained by the method of chemical control outlined in his article. The concluding number of his article on "Water Softening" will present some data as to the accuracy and value of the soap test in the experience of the Pittsburgh & Lake Erie Railroad.

PACKING TROUBLES OF THE "S. M. P."

To the Editor:

"Are we having trouble with packings?" said the S. M. P. "Well, I should say we were, it is the worst thing on the road. Just look at this pile of papers on the desk." They were about one foot high. He said, "All of them are about steam leakages on the front of our engines, and of course every one says they are packing, why things are so bad that this correspondence is from every one from the president down to the train master. Why don't I go down in the shop and see where the trouble lies and go out on the road some? Well, how can I find time with such a batch of correspondence to answer, it will probably consume the entire day in this work, so that I have no time to go down into the shop or out on the road, except when particularly ordered to do so by the G. M. Why, this packing trouble is so bad that every time there is a train detention the engine men report packing trouble as the cause of it, and it is getting to be a more universal complaint than wind. Only the other day one of our men was running backwards and got into something and then stated that he could not see signals on account of steam leakages from the front of the engine. All the boys are getting on to it and are making it responsible for most of their mistakes.

"Did I see an article published some time ago in one of the engineering papers about packing troubles and the way to correct them? I did, but it was several months after the article appeared and then only because it was sent to me by one of our vice presidents, who happens to be connected with the financial end of our road, whose uncle previously owned reams of our stock, every once in a while he worries me by sending letters about articles in technical papers. The article he referred to was pretty good, but of course I did not have time to find out, as the answers of 'why is this thusly' correspondence takes up most of the time.

"I can spare a little time to talk to you about this trouble, while the chief clerk is looking up some of these references. Several years ago things got so bad that we had a packing expert live with us awhile, and it is really surprising how much good that fellow did, our engines were not only decently steam tight, but it would cost us a good deal less to maintain packings if they were handled as he did it, but he was not in our employ, so, of course, when he left, things, somehow or other, drifted back in the old condition. We had him instruct all the men he could get a hold of, but as they had a whole lot of other things to remember, and as packing did not tie up a road as badly as hot driving boxes and broken stay bolts, it was not kept up as he suggested.

"You say that our roundhouse men are not making proper repairs to packing? Well, it seems rather queer if this should be so, as the roundhouse foreman is an old engineman himself. That fellow used to run the general manager's engine, but of course when he got too old for that we had to find something for him to do, so we put him in charge of the roundhouse. It would never do to lay him off after such valuable service and how else could we use him? He may not keep the men up probably as well as a younger man would, but still he gets the engines out. You say that he does not require the machinists to apply proper size rings to packing and to see that the other parts of the packing are all right? We must stir him up on this point, and it may do some good. Then again you say we are not properly manufacturing our packing rings. We have given proper instructions on this point, and if they are carried out will produce good results, but of course it is as you say, there is an old lathe on this work, but then we could use the lathe on nothing else, it was too badly worn to do some of our particular work, so packing rings were about the only things left for it. We cannot scrap the lathe, for that would bring the whole establishment down on us, and then the tools that are used in the lathe were designed by one of our best foremen and we might lose him if we changed over to another system of ring manufacture, at least I would have to continually butt against him, and as he is foreman of that department I naturally depend upon him to see that the work is properly done, but you may be right in saying that at times it is fairly done and then again it is not!

"Why don't we buy the rings from some packing concern? To suggest that to the general manager would almost be like handing in my resignation. I would immediately have to explain, we could manufacture the rings cheaper per set than the manufacturer or show why, then by suggesting to purchase something which was costing us more than we could manufacture for ourselves. I would be putting myself in a poor light. Of course per engine mile we would be saving considerable money by purchasing them outside, made of proper metal and machined to fit, but it is hard to explain this to him, and we have to take care of enough figures nowadays to set a college professor crazy, without adding any more about packing. We have tried other designs of packing, in fact about everything on the market, and keep on trying them with about the usual result, that is, they show up finely on tests but when put into regular service give even worse results than our standard. Of course some packings are better than others and I think we are buying the best on the market, at least this is borne out by the fact that most other roads are using it and the whole trouble comes when the packing requires new rings, and then I will admit that things do get pretty bad.

"How to correct this trouble? Well, that is pretty easy to talk about, but it is entirely another matter to compel. The proper way would be to specialize it as we do our air brakes, and have trained men on it. These special men would of course cost money, then when it came time to reduce expenses these men would be pointed out as an unnecessary expense, and we would probably lose them and then things would drift back into their old conditions.

"I can't talk to you all day on this question as the chief clerk is about due again and I will say, that if you are earnest in try-

ing to get people to correct this kind of trouble it will either be necessary for the management to specialize packing and appoint a proper person to enforce proper use of it, or see that railway officials are not overloaded with work, so that they may attend to details of this nature as they should be attended to. By this I mean that we should have good live instruction and well paid men, as both shop and roundhouse foremen, so that the other mechanical officials shall have time enough to devote to matters of this kind."

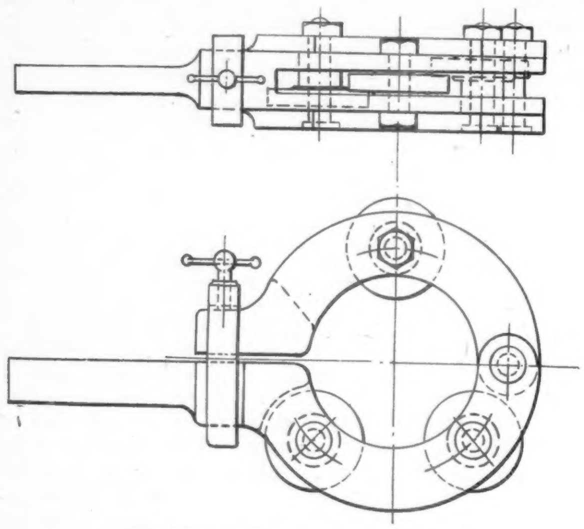
P. A. C. King.

BURNISHING TOOL FOR PISTON RODS.

To the Editor:

I enclose a sketch of a tool devised at the Carbondale shops of the Delaware & Hudson Company. It has been customary when a new piston rod was wanted, to turn the material to the desired size and then file it smooth and finish it by polishing with emery and oil applied by means of a pair of wooden clamps. This process requires considerable time to obtain a good result.

A better scheme is to grind the rod, but such a process requires a grinding machine which all shops do not possess. With the tool shown, however, a regular finish cut is taken over the rod, the tool is then secured in the tool post and closed around the rod, the rolls being tightened by means of the screw clamp. A fine feed is then put on and with the proper lubricant the rod is rolled as smooth



BURNISHING TOOL FOR PISTON RODS.

as can be desired. The contrivance is not very costly, its construction being shown by the sketch. It need hardly be remarked that the rolls and the pins upon which they turn are to be made of tool steel and hardened. An advantage of this method is that by the rolling a hard compact skin is formed which makes a good wearing surface. There is also a great saving of time.

Edw. B. McCabe.

[Editor's Note.—This is a convenient burnishing tool, but the importance of installing grinding machinery should not be lost sight of where there is sufficient work of this kind to justify it. The subject of burnishers was referred to in this journal on page 337 of October, 1898, and on page 156 of May, 1899. Mr. L. Bartlett, of the Missouri Pacific, mentions the origin of the method by himself in 1891 on page 228 in July, 1899. On page 57, in February, 1900, the Pennsylvania burnisher was illustrated.]

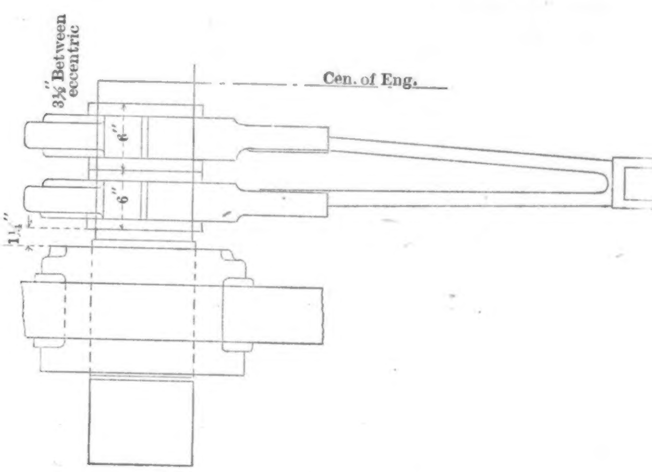
Oil Fuel in Blacksmith Shops.—From my point of view, oil at 6 cents per gallon and coal at $5.00 per ton about balance, as far as the cost of the two fuels is concerned. The improvement in the quality of the iron produced by heating with oil is incalculable. An important factor in the operating expense is the power required for atomizing the oil and furnishing oxygen to produce perfect combustion. Compressed air I find to be an expensive commodity. Steam is also expensive, and from my experience is not as good as compressed air for the purpose. In my experience the old fan blast that is so well known in all forge shops is the cheapest and best when properly applied. From 8 to 10 ounces pressure is all that is required.—S. Uren, *before National Railroad Master Blacksmiths.*

WALSCHAERT VALVE GEAR FOR LOCOMOTIVES.

The new 2—8—0 locomotive of the Lake Shore & Michigan Southern Railway, fitted with Walschaert valve gear, was illustrated on page 46 of the February number, and attention was directed to the accessibility of the gear, its light weight and the uniformity of the lead.

Of these features, that of accessibility is doubtless the most important. The eccentrics of the Stephenson gear of a large freight locomotive are now so large, and the room in which to put them is so small, as to render them practically inaccessible, and they do not receive proper attention, either in the shop or on the road. As an example of crowding of eccentrics, the accompanying engraving is presented, by courtesy of the American Locomotive Company, which illustrates one of the worst cases found necessary in the design of a 2—8—0 type freight locomotive. With a long driving box and eccentrics 6 ins. wide, there is but 3½ ins. of space between the middle eccentrics on the axle. The rods take up vastly more room than the eccentrics, and on examining a modern heavy engine, it is not surprising that men dislike to crawl into such a mess on the road, in case of trouble, where pits are not available.

Walschaert gear has been used for many years abroad, and



EXAMPLE OF CROWDED ECCENTRICS.

its development has been carried to a fine point in the deGlehn compound (see American Engineer, June, 1904). In is application in this country it will be necessary to secure ample bearing surfaces and direct lines of pull and thrust, which are important in every valve gear. The weight is an element of extreme importance, because of the work which must be done at high speed in overcoming the inertia of ordinary gears weighing a ton and a half, with frequent reversals of direction. This is believed to have more effect in causing heating of eccentrics than the work which the gear is required to do in moving the valves.

In the case of the Lake Shore engine the men like the valve gear, and it appears to be in every way successful. The future of this gear in this country is not, however, dependent upon this particular engine. It will be surprising if the gear does not become a regular feature of American locomotive practice.

Machine shop profits of the present day are made up of time that used to be wasted by the old methods

Low Labor Cost for Cast Iron Wheels.—In a recent number the *Railway Age* described interesting equipment for a continuous process of casting car wheels, stating that the plant will produce 350 wheels in ten hours with 36 men, making a total labor cost of 24c. per wheel from mould to pit, inclusive. With the application of an additional improvement a further saving is expected, making the total cost for foundry labor 45c. per wheel, a reduction of 20c. per wheel from the old system.

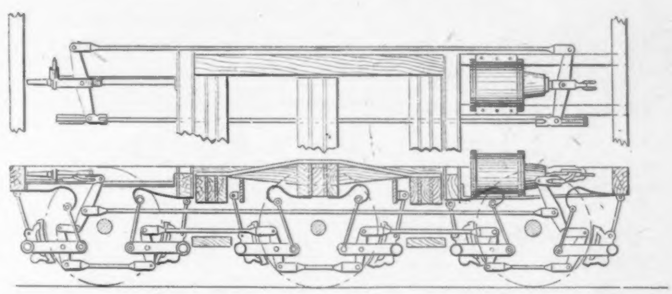
BILL MILLER'S PARDON, OR THE TRIBULATIONS OF A ROUNDHOUSE FOREMAN.

William J. Miller ('course the name is fictitious),
Is a man who was never at all superstitious;
But a dream which he had is direct intimation
Of his faith in the doctrine of predestination.
Now, the said William Miller, please bear in your mind,
Is a bright roundhouse foreman, who, like all of his kind,
Has trials and troubles too many to state—
And with this introduction his dream I'll relate.
A spirit appeared at his bedside one night.
Decked out in a garment of pure, spotless white,
And thus addressed Bill: "To me has been given
Command from the Recording Angel in heaven
To ascertain why 'tis your name should appear
On the Great Book of Life, as the reason's not clear.
The profanity record has been kept for ages,
But nothing like yours appears on its pages;
Therefore, 'tis decided, unless you can show
Just cause for defense, to send you below,
Where the fire in unquenched, and those who have never
Repented, are roasted for ever and ever."
On hearing the latter, Bill tried hard to smile,
And invited the spirit to tarry awhile.
"If I fail to make my defense in full measure,"
He said, "I'll be sentenced with greatest of pleasure.
Please remain here to-morrow, accompany me,
And report to headquarters whatever you see."
The spirit agreed, I am happy to say,
And took note of what happened the following day.
First, a conceited young clerk, with expression satanic,
Brought a bundle of letters from the master mechanic.
And here a few extracts I'll give as example
Of the bunch that the spirit took away for a sample:
"Please note that the superintendent complains
You are using poor coal for our passenger trains."
"Please let me know what excuse you can make
Why so many new compound packing rings break."
"Engine failures, last year, for the month were but seven;
I regret for the same time this year there's eleven."
"You must take up the matter and ascertain why
We used so much oil in the month of July.
You are surely aware that a half pint to use
Of valve oil per hundred is simply abuse;
I believe 'twould be wise (at least we can try it)
To give engineers feathers with which to apply it."
"The president's special is leaving to-day,
At 10.25; there must be no delay."
But, alas! for the plans of mice and of men!
The telephone rang at a quarter of ten,
And the voice of the callboy announced with a drawl:
"De fireman is sick. Who else will I call?"
A fire-up man appeared just then at the door:
"The crown sheet is down in the 74."
Then next comes an engineer, swelled like a toad—
You'd think from his looks that he'd surely explode—
And asked loud in the name of the evil one:
"Why hain't the work on *my* engine been done?"
Bill Miller, he then made an angry retort;
While the spirit examined the work report
Of this same engineer, and this was the news:
"Wash out the biler and boar out the flews.
The seems are a squirtin'. Cork all the leaks.
The rite back driver box is so dry that it squeeks.
Steam pipes are leaking. Pack throttle well.
Right mane pin cut and runs hotter than —— (it should).
All the rod bushings are lose on both sides.
Set up the wedges and line up the gides.
The air pump jerks on the upward stroak.
Exzamin' and see if the valve ain't broak.
Take down left mane rod, reduce the brass,
And don't fail to put in a watter glass.
Raze the frunt end an inch or more,
And fix the ketch on the fire box door.
I think from the way she burns her fire
Her petticoat should be a little hire."
Before the good spirit got through taking notes
From the book containing the work reports,
From the chief dispatcher came a message which read:
"The Golden Gate Special's engine is dead.
Send another at once to take the train.
Why you sent this one on 21 please explain."
Then the hostler announced that a broken switch
Had caused him to put engine 12 in the ditch.
The spirit departed, but on that same night
Returned with a crown, and in greatest delight
Presented to "Bill's" most astonished vision
A text of the Recording Angel's decision,
And a list of the great hero saints all revealed,
With William J. Miller's name leading the field.

—*N. M. M. in Locomotive Firemen's Magazine.*

IMPROVEMENT IN BRAKING SIX-WHEEL TRUCKS.

In order to apply brake shoes to both sides of each wheel of a six-wheel truck, thus avoiding the tilting tendency produced by break beams on one side of the wheels only, and to equalize the brake rigging on trucks of this type, a new arrangement has been patented by the Westinghouse Air Brake Company, which contains a number of interesting features. Usually, trucks of this type have but three brake beams, and many of them have but two. The construction suggested in the accompanying engraving employs a brake cylinder supported upon the truck itself, the piston rod being connected to the cylinder lever, one end of which is connected to a vertical equalizing brake lever, while the other end connects to a pull rod extending to a corresponding lever at the other end of



SIX BRAKE BEAMS APPLIED TO SIX-WHEEL TRUCK.

the truck, the latter lever being fulcrumed on a slack adjuster. The brake beams have the usual hangers suspended from the truck frame, and they are arranged to carry the brake shoes on both sides of all the wheels. Brake beam levers are mounted on the brake beams with intermediate lower and upper rod connections. The equalizing brake lever at the right is connected at its lower end by a link with the first brake beam lever, while at an intermediate point it is connected by a pull rod with the vertical equalizing lever at the left. To support the stresses in the truck, struts are built into the frame, one of which is shown in the plan view. The engraving also shows the attachment for the hand brake at the cylinder. With this arrangement, the power will be equalized throughout the system, applying all the shoes to the wheels with equal pressure. This system is not known to have been applied to actual construction. It is presented as an exceedingly interesting development, meriting the attention of those concerned in the braking of present heavy equipment.

ELECTRICITY SUBSTITUTED FOR STEAM.—Mr. L. B. Stillwell stated before the International Engineering Congress the opinion that the application of electricity should not even be considered for steam roads on which the present traffic is not more than 10,000 ton-miles per mile of double track. The saving in cost of transportation by electricity over steam with a traffic density as low as this is more than offset by the charges on the increased capitalization.

YOUTHFUL INVENTORS.—Thirty days after the appearance of the first published accounts of Bell's invention of the telephone, two New York boys had built and were successfully operating an experimental telephone system of their own. These two boys have since achieved distinction in the electrical field, and have for many years been allied in business. They are Prof. Frank B. Crocker, of Columbia University, and Dr. Schuyler Skaats Wheeler.

DIRECT VERSUS ALTERNATING CURRENT IN ELECTRIC TRACTION.

The following comparison of the direct current and single phase alternating current systems for electric traction is taken from a paper on "Developments in Electric Traction" by Mr. W. B. Potter, read before the January meeting of the New York Railroad Club. This comparison is especially valuable coming from the standpoint of one who represents successful practice on a large scale, and who has devoted so much time to study and practical work along these lines.

A great deal has been written concerning the possibilities of single-phase tractioh and, as is often the case with the development of a new principle, many appear to have formed too optimistic ideas of its capabilities. While we recognize the advantage of such a system in many cases, it is a mistake to imagine that it will be a cure for all ills and revolutionize the railway world. It is well, therefore, to have a clearer idea of the advantages and disadvantages of single-phase traction and also to analyze the reasons governing the choice of such a system. It is self-evident that the relative expenditure for equipment, operation and maintenance, should be the fundamental reason governing the selection of a system for any particular service.

The single-phase A. C. system possesses two features which recommend its use; economy of trolley copper, due to the higher trolley voltages, and the elimination of the rotary converter. The chief advantage gained by these features is a saving in the initial cost of equipment: factors which increase in importance in proportion to the amount of power required by each car or train and with the length of the trolley line. On the other hand, the A. C. car equipments cost more than the D. C. equipments for a similar service and the same given rise in temperature of the motors. It is, therefore, apparent that the relative cost of an A. C. or D. C. system will be materially affected by the number of cars employed.

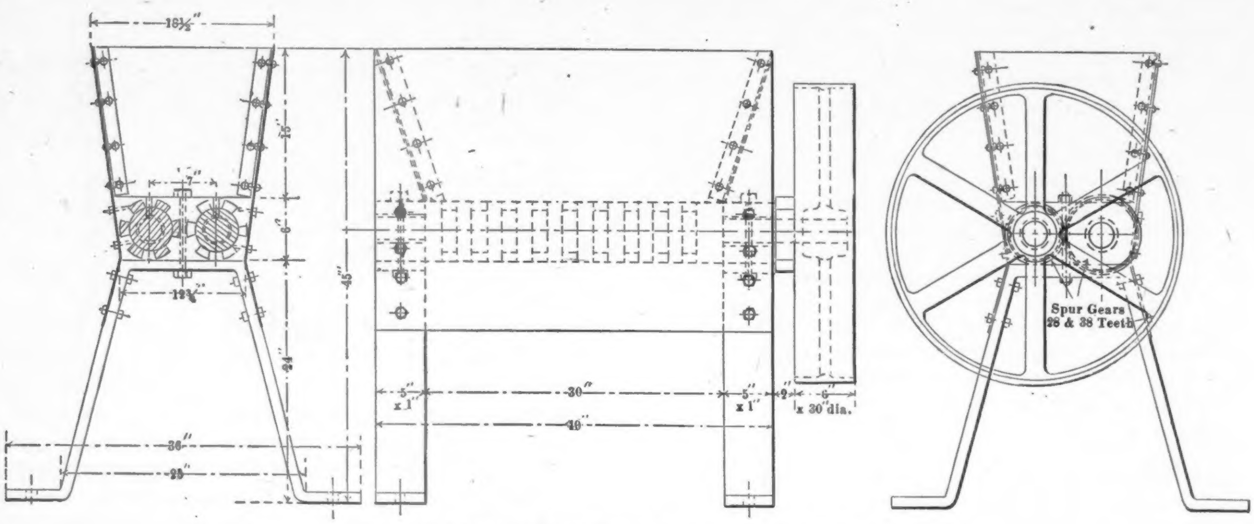
The saving in power resulting from the elimination of the rotaries is about off-set by the greater weight and slightly lower efficiency of the A. C. motor.

The efficiency of the A. C. control, during acceleration, will, generally speaking, be somewhat higher than that of the D. C. system with series parallel control. With the A. C. system fractional voltages can be obtained from the transformer on the car. Each step of the A. C. controller gives a running position which corresponds with the series and parallel positions in a D. C. controller.

The potential of the transmission lines from the power station may be selected, as in the case of the D. C. system, without reference to the trolley or secondary voltage. The trolley voltage must, however, be considered from a different basis than that of the D. C. system for the reason that in addition to the ohmic resistance of the trolley and track circuit, there is an apparent increase in resistance, due to the alternating current. This increase in apparent resistance for 25 cycle alternating current, as compared to direct current, is about 50 per cent. in the trolley wire and between six and seven times greater in the rail return. The rails being steel, the increase in apparent resistance is relatively much greater than in the trolley wire. As the resistance of the track return with large steel rails is proportionately much less than that of the trolley wire, the apparent increase in resistance for the latter and the track taken together will be, roughly, from one-half to twice that for direct current. An alternating current at 1,000 volts, is, therefore, about equivalent to 600 volts direct current so far as affecting the amount of trolley copper, and to secure the advantages of the A. C. system to a reasonable degree at least 3,000 volts or, for heavier service, perhaps 5,000 volts must be employed.

The design of an A. C. motor as regards length of air gap and armature speed is affected by the lower average flux density. For this reason an A. C. motor is larger and heavier than a D. C. unit of the same output. The commercial A. C. motor represents a compromise in which the armature speed is somewhat higher and the air gap slightly less than would be the case in a D. C. motor of corresponding capacity. I have mentioned these facts to indicate that the maintenance of an A. C. motor will, in all probability, be greater than that of an equivalent D. C. motor, due both to the higher armature speed and the smaller air gap.

The equipment of heavy locomotives with A. C. motors for high speed passenger service is a possibility, but owing to the limitations imposed by the space available, for the motors, it seems probable that two locomotives, each with four motors, would be required for service which could be performed by a single D. C. locomotive with four gearless motors. For locomotives in slow speed work, such as freight or shifting, a double gear reduction will, in many cases, be required, owing to the difficulty of winding an A. C. motor of large size for slow speeds.



COKE CRUSHER—PITTSBURGH & LAKE ERIE RAILROAD.

COKE CRUSHER

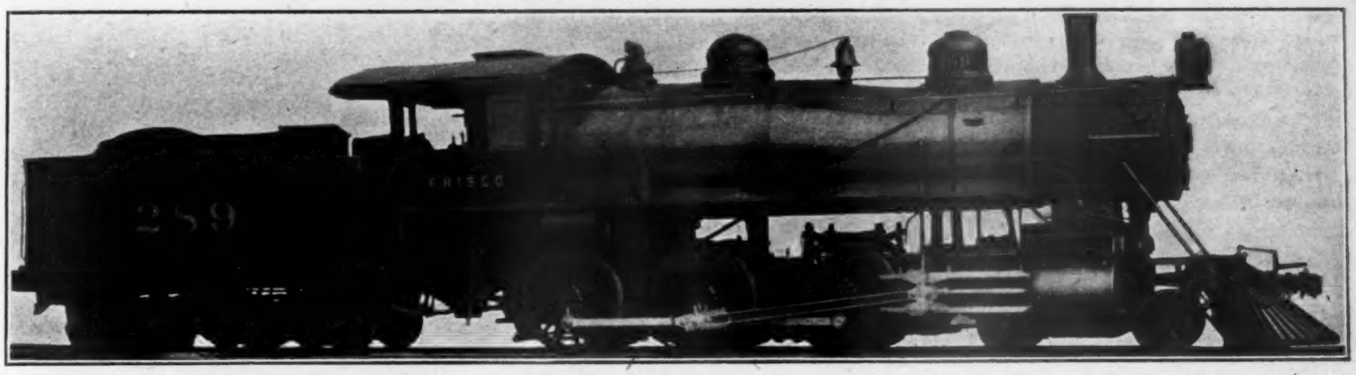
The drawing shows a simple but efficient coke crusher which can readily be made at a small cost and which running only part of the time will crush all the coke required in a large blacksmith shop. The rollers are made from old driving axles and are 6 ins. in diameter. Longitudinal grooves 1 in. deep are cut in one of the rollers, while the other one in addition to the longitudinal grooves has a series of circumferential ones, thus covering its surface with coarse teeth. The rollers have their bearings in cast iron blocks, which are bolted to the 5 x 1-in. wrought iron supports. The hopper is made of steel plates, fastened together at the corners by light angle bars. The driving shaft operates at a speed of 78 r.p.m. This machine was made and is in use at the McKees Rocks shops of the Pittsburg & Lake Erie Railroad. We are indebted for the drawing and information to Mr. W. P. Richardson, mechanical engineer.

ADVANCE IN MARINE ENGINEERING.—Mr. Charles H. Haswell designed the machinery of the *Fulton*, of the United States Navy, the first steam war vessel. Rear Admiral Melville stated before the American Society of Mechanical Engineers that her engines worked with 11 lbs. steam pressure, 24-in. vacuum and turned at 18 r.p.m. The remarkable contrast with present practice is emphasized by the fact that Mr. Haswell is now living and has personally seen the entire development of the application of steam to war ships.

FOUR-CYLINDER VAUCLAIN BALANCED COMPOUND LOCOMOTIVE.

4—6—0 TYPE—'FRISCO SYSTEM.

The Baldwin Locomotive Works have delivered to the 'Frisco System, for use on the Chicago & Eastern Illinois, a four-cylinder balanced compound, on the Vauclain system, which is an interesting example of the application of balanced compounding to a six-coupled engine. This engine is designed for freight service, and the firebox extends over the driving wheels. With the exception of unusually long guides and piston rods, the engine in appearance resembles the usual construction for 4—6—0 engines. The high-pressure cylinders connect with the forward axle and the low-pressure connect to the second axle. This design differs from that of previous six-coupled designs of this system, illustrated in this journal, in the connection of the outside main rods to the second pair of drivers. The chief dimensions are given in the accompanying table:



VAUCLAIN 4-CYLINDER COMPOUND LOCOMOTIVE—'FRISCO SYSTEM.

W. A. NETTLETON, *General Superintendent of Motive Power.* BALDWIN LOCOMOTIVE WORKS, *Builders.*

4-CYLINDER VAUCLAIN BALANCED COMPOUND 'FRISCO SYSTEM.

Gauge	4 ft. 8½ ins.
Cylinder	15½ ins. and 26 ins. by 26 ins.
Valve	piston
Boiler—Type	wagon top
Diameter	64 ins.
Thickness of sheets	⅝ in., 11-16 in. and ¾ in.
Working pressure	225 lbs.
Fuel	soft coal
Staying	radial
Firebox—material	steel
Length	101⅞ ins.; width, 66 ins.
Depth	front, 70 ins.; back, 58¼ ins.
Thickness of sheets	sides, ⅜ in.; back, ⅜ in.; crown, 7-16 in.; tube, ½ in.
Water space	front, 4 ins.; sides, 3½ ins.; back, 3½ ins.
Tubes—material	iron, wire gauge No. 11
Number	278; diameter, 2¼ ins.; length, 18 ft.
Heating surface—Firebox	160.7 sq. ft.
Tubes	2,933.7 sq. ft.
Total	3,094.4 sq. ft.
Grate area	46.69 sq. ft.
Driving wheels—diameter outside	62 ins.
Diameter of center	56 ins.
Journals	front, 10 ins. by 10¾ ins.; others, 9 ins. by 12 ins.
Engine truck wheels, front	diameter, 30 ins.
Journals	5½ ins. by 10 ins.
Wheel base—driving	13 ft. 6 ins.
Rigid	13 ft. 6 ins.
Total engine	27 ft. 7 ins.
Total engine and tender	55 ft. 8 ins.
Weight—on driving wheels	134,920 lbs.
On truck, front	49,840 lbs.
Total engine	184,760 lbs.
Total engine and tender (about)	302,000 lbs.
Tank—capacity	6,000 gallons
Tender—Wheels, No. 8	diameter, 33 ins.
Journals	5 ins. by 9 ins.

SYSTEMATIZATION AND TOOL-ROOM PRACTICE IN RAILROAD SHOPS.

The following is taken from a very valuable article on the "Systematization and Tool-Room Practice in a Railway Repair Shop," by Mr. R. Emerson, which appeared in *The Engineering Magazine:*

System as applied to one small tool room is a paying investment in the tools saved, and in the facility with which the proper tools are available when wanted. System as applied to the tool regulation on the whole railroad pays, not only to this extent, but to an even larger degree in the standards it is possible to establish, and in the decreased cost of production due to manufacturing locomotive parts by these standard tools on large scale, and accurately, so that they will fit in distant roundhouses. For instance, in the locomotive repair shops the customary method has been to ream out the old frame-bolt hole with standard-taper reamer, but without any given diameter. The new method would call for a series of diameters of these taper-bolts varying by 1-32 in. An engine passing through the shops would have all her frame holes reamed out to the size next larger than the one previously used. This could be done with a standard shoulder reamer of high-speed steel, the resulting hole perfectly accommodating the bolts in stock. Such a stock of bolts on one of the large railroad systems in this country represented an investment of less than $1,200. Needless to say, the interest on this sum and on the somewhat more expensive tools was insignificant, compared to the greater expense of putting in bolts in the old individual way. It is the province of the tool man to care for these reamers, and to keep them to standard. In order to do this properly, a tool system is needed whereby it will be impossible for a man to have one of them in his possession long enough for him to wear it below standard size.

For the whole system the tool-room may standardize the manufacture and application, as noted above, of frame bolts, or of knuckle-joint pins, or staybolts. The methods in the case of the last two items were very similar. For the pins, standard "taper-shoulder" reamers were provided for each size or class of pin, the number of such classes being reduced to a minimum—in the case I have in mind, four. Each class or nominal size was provided in four diameters, verying by 1-16 in. All new work was reamed to the first and smallest diameter, and at each subsequent overhauling to the next larger diameter. The use of these shoulder-reamers and their distribution to every shop and roundhouse of any size on the railroad system made possible the manufacture of these pins by turret lathe methods, to standard diameters and in large quantities, and the distribution of these pins as stock to the points where they would be needed, thus saving entirely the expensive method of turning each pin separately as occasion required and time pressed. Staybolts also are made very accurately to standard diameters, varying by 1-16 in. and 1-32 in., and to various lengths, sample staybolts of each lot being accurately gauged for size by limit-thread gauges. Stock of these bolts is distributed in similar fashion to that of frame bolts and pins, accurate fitting of the staybolts being insured by the maintenance, by frequent inspection throughout all the shops, of standard size of staybolt taps. When this manufactured stock of staybolts is first furnished, a complete canvass of every staybolt tap on the road is made in person, by some one competent for the job. These taps are permitted to be used only while they are within 3-1000 of size, all others being scrapped.

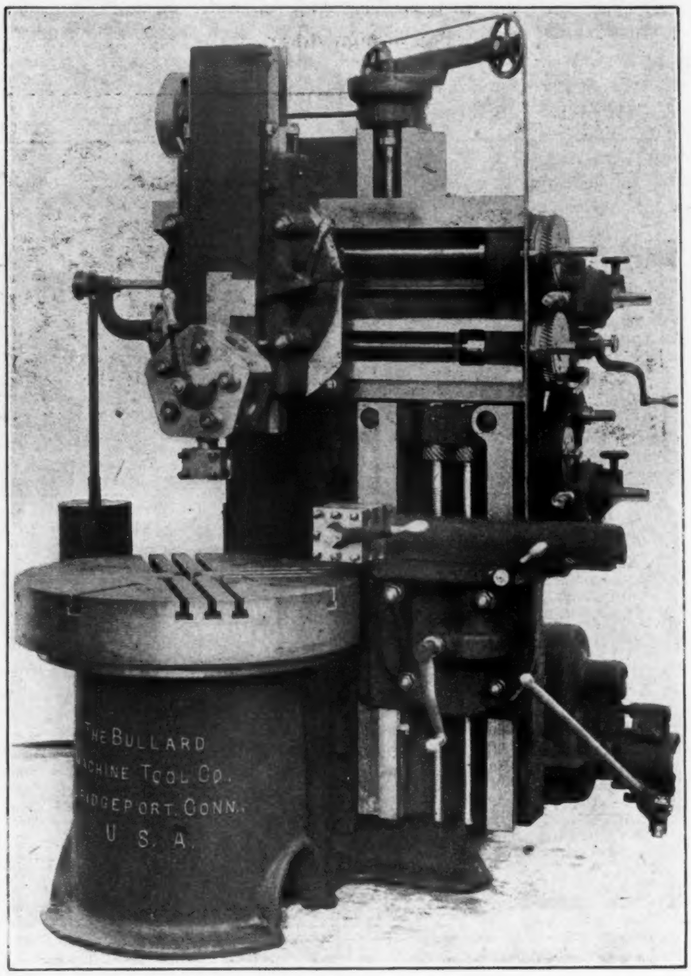
Of course, one must have a man, one with large ideas, ex-

perience and inventive fertility—presumably an expensive man—at the head of this tool system. He will see to it that the tool-room furnishes templets, jigs and tools for the rapid production on large scale of standard parts before it is forced to do so by the reiterated demands of some of the more progressive foremen; in other words, that the tool-room shall be leading the shop. The tool accounts on Western American railways vary from about $100,000 to $500,000 per year, and must reach over a million on such systems as the Pennsylvania. This sum sounds expensive for a mere incidental to locomotive maintenance; and it is expensive—extravagantly so—unless it is intelligently spent. Should this amount, however, be doubled, three to four times the additional expenditure could be saved in cost of locomotive repairs. It can be authoritatively stated that when tool expenditures are well systematized, the efficiency of the system as a manufacturing output cheapener is not only manifolded, but the actual cost of operating the system itself can be materially reduced—from 12 per cent. to 20 per cent. in cases under my own observation.

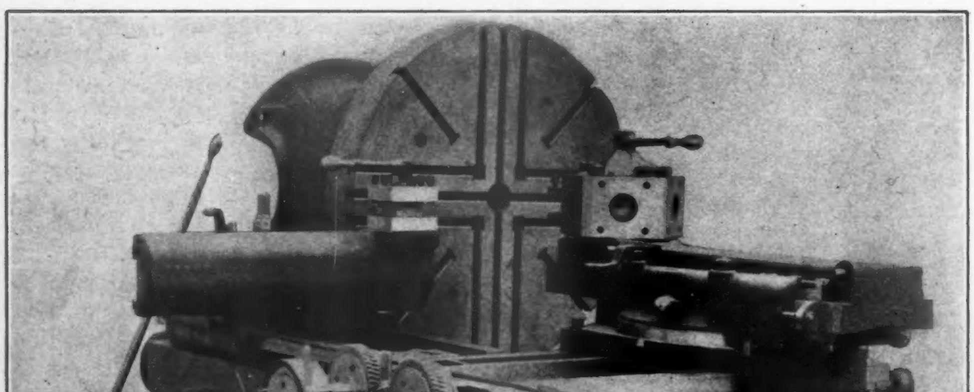
RAPID PRODUCTION VERTICAL TURRET LATHE.

For handling heavy face plate work the vertical mill illustrated in the photograph has several advantages over the horizontal lathe. The view of the mill lying on its side shows its close resemblance in that position to a horizontal turret lathe, and justifies calling it a vertical turret lathe. The advantages of the vertical type are that the work can be much more easily and quickly chucked, there is a freedom from vibration and chatter which is due largely to the heavy overhanging parts of the horizontal type, the frame or bed can be made more rigid, large spindle sizes and greater power are possible; the weight of the table, spindle and work rests directly on the large angular spindle thrust bearing and tends to preserve the alignment rather than destroy it; the side head does not make necessary the use of long boring bars and extended tool holders in the vertical turret, both heads may be operated jointly on work of small diameter without interference.

The vertical head will face 36 ins., has a vertical and angular movement of 26 ins., and may be set to an angle of 45 deg. either side of the center. The turret has five sides with holes for 2½-in. tools and has tapped holes for attaching special tool holders. The side head is equipped with a four-faced turret tool holder, has vertical and horizontal feeds and may be swiveled for angular facing up to 40 deg. either side of the horizontal. It has a vertical movement of 28 ins. and a horizontal and angular movement of 15 ins. The heads are operated independently and in no way interfere with each other. The feeds have safety points so arranged that carelessly permitting the heads to run together causes no damage or delay. This device does not weaken the feeds. Eight feeds, independent for each head, are provided and changes to any one of these may be made instantly by turning the star wheel to the proper point on the index plate. Change from vertical feed to cross feed or *vice versa* may be made instantly by engaging a centrally located drop worm with worm gears on the end of the feed rods. Pull gears are thus eliminated.



RAPID PRODUCTION VERTICAL TURRET LATHE—BULLARD MACHINE TOOL COMPANY.



VIEW OF VERTICAL TURRET LATHE, SHOWING ITS RESEMBLANCE TO HORIZONTAL TURRET LATHE.

By means of a speed box containing self-adjusting and powerful friction clutches, which are operated by a lever at the front of the tool, 15 table speeds may be obtained in geometrical progression. The table may be stopped instantly at any desired point by means of a brake without stopping the driving pulley. The table is 34 ins. in diameter, and is driven by an internal spur gear of large diameter. The cross and side rails have a vertical adjustment of 12 ins. by power.

All gears are encased and well lubricated. If desired the machine may be driven by a 7½-h.p. constant speed motor mounted on a bracket at the side or rear of the machine. The net weight of this machine, which is made by the Bullard Machine Tool Company of Bridgeport, Conn., is 9,000 lbs.

WHAT MOTIVE POWER OFFICERS ARE THINKING ABOUT.

EDITORIAL CORRESPONDENCE.

Grease lubrication for locomotives is increasing in favor. No adverse comments were heard. Where the Elvin driving and truck box grease lubricator has been applied hot boxes seem to have been greatly reduced in frequency. To say that hot driving boxes have become ancient history is asking too much credulity, but there is no doubt that this system of lubrication is a boon to the railroads.

One road had lots of trouble when grease was first applied to driving journals. Grease lubricators were put into a lot of new engines and they cut the journals and heated in a distressing manner. In this case it was discovered that the bearings, which were of bronze, were extremely hard. When replaced by softer brass the journals gave no trouble. Evidently Mr. Elvin's grease is particular as to the metal with which it associates. It must not have a "hard character."

Journals and bearings will undoubtedly wear more rapidly with grease than with oil lubrication, but if grease saves the cutting and scoring of journals due to heating, it is probable that the amount of journal material saved by avoiding frequent turnings of journals will more than compensate for the increased wear.

The lubrication problem is revealed in a new form by the locomotive superheaters. Important as they are in simple and compound locomotives, lubrication questions become vital ones in connection with superheated steam. Doubtless ordinary locomotives with the older types of lubricators depend in a large degree upon the water of condensation for their cylinder and valve lubrication. It is known that when a cylinder and valve are really lubricated with oil, the reverse lever will run a couple of notches higher than when the oil gets down slowly. The water of condensation, if it does not lubricate, at least carries off some of the heat, and as long as the engine will run the matter of oil lubrication does not compel the attention it deserves. Superheaters, however, are different. They will not run at all without excellent lubrication and here is where the superheater does a service to the ordinary locomotive. In the matter of piston rod and valve stem packing it will do a similar service. It is strange that lubrication and packing should depend upon the introduction of a new system which will not run at all with ordinary precautions in order to be made right. Every locomotive needs oil in its valves and cylinders from the very first stroke in starting. This requires a positive pump effect in the lubricator. The "big locomotive" needs all the help it can have from the best possible lubrication. Motive power people are quite ready to talk on this subject. They realize that it merits more attention.

Not so long ago hands came up in holy horror when increased driving wheel loads were suggested. That was before the days of 80-in. wheels. Now weights of over 20,000 lbs. per wheel excite little interest, although but few roads have been bold in this advance. The Pennsylvania uses weights as great as 29,500 lbs. per wheel, the Burlington 25,000 lbs. and the Lake Shore comes out with its new 2—6—2 type passenger locomotive with 29,000 lbs. per main wheel. The Burlington engine is balanced while the others are not, and yet there is believed to be no danger to the track. Of course, bridges are heavier and track better than formerly. These improvements are gradual and all roads are not alike in providing them. Inasmuch as increased wheel loads constitute the best possible traction increaser it is to be hoped that progress will be more rapid in this direction. The 4-cylinder balanced compound is an effective influence in this direction. Its possibilities are far from being exhausted.

Roundhouses should be equipped with more labor-saving appliances. There can be no possible question of the absolute necessity for cranes in roundhouses. Locomotive parts are becoming too heavy to be handled by hand labor, and in the absence of suitable facilities, absolutely necessary work which should be done in the roundhouse is left for the general overhauling in the shops, and engine failures as well as costly repairs are the result. We know how roundhouses can be built so that cranes may be used and yet progress in this direction is very slow. It would pay the railroads to equip their roundhouses to deal entirely with light repairs and thus keep many locomotives out of the shops. An ounce of repairs in the roundhouse is worth a ton in the shops. Every important roundhouse should be fitted up to expeditiously handle running repairs in order to reduce engine failures and increase locomotive mileage between shoppings. Opinions as to the roundhouse are undergoing radical changes, and the present tendency is to consider their repair functions as paramount. It is significant that a roundhouse illustrated about three years ago in this journal as being an excellent example of up to date practice is now considered obsolete and none of its fine points are considered applicable to a new roundhouse just put into service on the same road. It is also apparent that railroads are beginning to learn that locomotive operation, including roundhouse management, requires a very superior superintending ability.

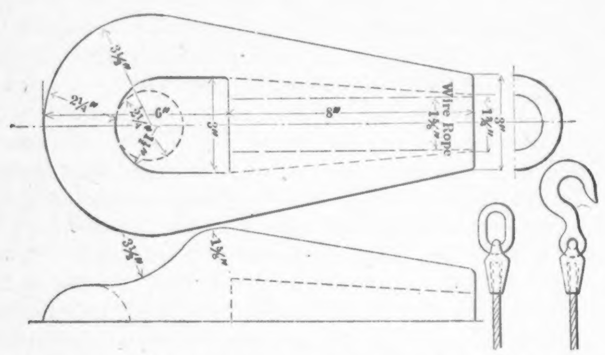
Superheating as applied to locomotives is attracting the attention of railroad men in a remarkable way. So also are the four-cylinder balanced compound principle, the automatic stoker, and, in fact, every other principle which seems at all likely to contribute in any way to the economy of the operation of locomotives. Railroad men have never been blind to possible economies, but they are now interested in them for a new reason, which may as well be plainly stated. It is the limitation of firing. This presents a reason which never existed before for the improvement of the locomotive. No one in this country would have seriously considered such an improvement as superheating from the standpoint of locomotive efficiencies alone, but when it presents the possibility of enabling the fireman to shovel more horse-power into the firebox, it is looked upon with favorable interest. One American road, the Canadian Pacific, already has over forty locomotives equipped with superheaters; the New York Central has one, and several other roads are about to try them. The superheater, which came to us from Germany, has been improved and adapted to our conditions, and is about to be improved still further, so that superheating may be carried to a point limited only by such questions as are imposed by lubrication and packing. Of all the possibilities in the direction of increasing the efficiency of locomotives at the present time, this one appears to be most promising. It is a development which should be most carefully watched by all. If it should bring some new troubles it will also bring new blessings, and those who are facing the problem of supplying additional capacity for sustaining high power in locomotives should not await the results of the experiments of their neighbors, but should undertake experiments themselves. This applies to other devices besides superheating, and no railroad desiring to be progressive can afford to wait a day in unnecessary delay at this critical time of "engine failures."

ENDURANCE TEST OF ELECTRIC LOCOMOTIVE.—A continuous run of 900 miles in 14 consecutive hours has been made by the electric locomotive built by the General Electric and the American Locomotive companies, on the New York Central track near Hoffmans, N. Y. The behavior of the bearings was entirely satisfactory. This was not as severe as a straightway run of 900 miles, because the experimental track is short, compelling frequent stops and reversals.

UNPROFITABLE STREET RAILWAYS.—The street railway returns of the year, stated in the advance sheets of the 36th Annual Report of the Massachusetts Railroad Commission, are suggestive. Of 74 companies operating 2,654 miles of main track, 30 failed to earn expenses and fixed charges; 25 paid dividends; of the 25 which paid dividends 14 earned them during the year. Five companies, as stated above, have been in the hands of receivers.

A SOCKET FOR CRANE SLINGS FOR LIFTING LOCOMOTIVES.

In response to an inquiry for a rule for designing sockets for crane slings for lifting heavy locomotives the accompanying sketch has been secured, which illustrates a socket made for use in connection with a flexible steel cable. The usual way for fastening the cable is to splice an eye in the end, forming a loop on a thimble enclosing a link or hook. The sketch illustrates a wrought iron cone socket into which the cable is leaded. It forms a simple and secure method of fastening and is in use in the locomotive erecting shops of the Delaware, Lackawanna & Western Railroad at Scranton, Pa. The dimensions are intended to be liberal and the construction is the same as that employed on the Brooklyn and the Niagara Falls suspension bridges, although the proportion of the sockets are not the same. This socket has more liberal dimensions than those on the market, which is believed to be



SOCKET FOR CRANE SLINGS FOR LIFTING LOCOMOTIVES.

good practice, considering the danger of injury to many men which the fall of the locomotive would cause.

A cable ordinarily 1⅝ in. in diameter is used and the sockets provide for a link at one end of the sling and a hook at the other. With a double crane hook two links are provided. Of course this sling is used for the front end of the locomotive only. In leading in these sockets, after being threaded through the small ends of the cones the wires were frayed out and many of the ends of single wires were bent over into the shape of hooks so that when the melted lead was poured in it ran around each separate wire and formed a solid cone shaped bulb on the ends of the sling. In order to guard against the possibility of the cable drawing through, a small quantity of antimony is used to harden the lead. The sockets are made of wrought iron.

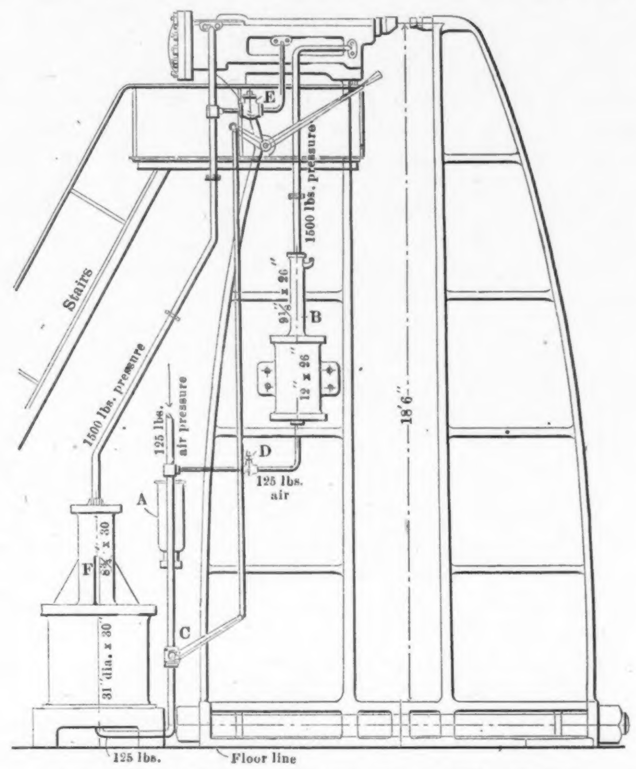
Young Men's Christian Association Results of the Year.—Mr. E. M. Willis, secretary of the railroad department of the International Committee of Young Men's Christian Associations has transmitted a new railroad department pamphlet entitled "Results of the Year," which describes graphically and concisely the remarkable development of the association work among railroad men during the year 1904. New buildings have been occupied at 16 different points; four buildings have been enlarged to accommodate the growing membership and 29 different railroad companies have co-operated in contributing the fund of $306,300 expended on these 20 buildings. Eleven of the 16 buildings are for new associations and associations have been organized at five other points during the year. The educational work has shown a gain of over 40 per cent. in twelve months. New members to the number of 9,800 have been added, making a total membership for 208 associations of 72,148. The total average daily attendance at these buildings was 37,419 during the year. The heartiest support and co-operation is credited to the men themselves and it is hoped that the railroads will do their part in meeting the needs of their employees. New buildings are practically assured at 16 additional points. The pamphlet illustrates a large number of buildings in all parts of the country, and the magnitude of the work is indicated, which cannot fail to make it a very powerful influence among railroad men. The pamphlet closes with the following quotation from the Hon. Paul Morton: **"The Railroad Young Men's Christian Association is good for the men, better for the company, but best of all for the public."**

HYDRAULIC RIVETER OPERATED BY A NEW SYSTEM

This riveter has an 18 ft. 6 in. gap, a riveting capacity up to 150 tons and a plate closing capacity of 30 tons. Under the new system by which it is operated no hydraulic pumps or accumulators are required and costly hydraulic valves and high pressure water mains are done away with. The hydraulic pressure of 1,500 lbs. per sq. in. is uniform and the machine is free from shocks caused by the dropping of the accumulator when the pump and accumulator system is used.

The arrangement for operating the machine is clearly shown in the drawing. By means of the lever which controls the three-way valve C, air at 125 lbs. pressure per sq. in. is admitted to what is known as the large differential. This consists of the small 8¾ by 30 in. water cylinder F, and the large 31-in. air cylinder. The ram which compresses the water in the upper part of the smaller cylinder is connected to the same rod as the piston in the air cylinder.

As compressed air is used in practically all boiler and bridge shops, hydraulic machinery operated by this system can readily be added to the equipment without installing an expensive hydraulic system. A substantial saving in the cost of



HYDRAULIC RIVETER OPERATED BY A NEW SYSTEM.

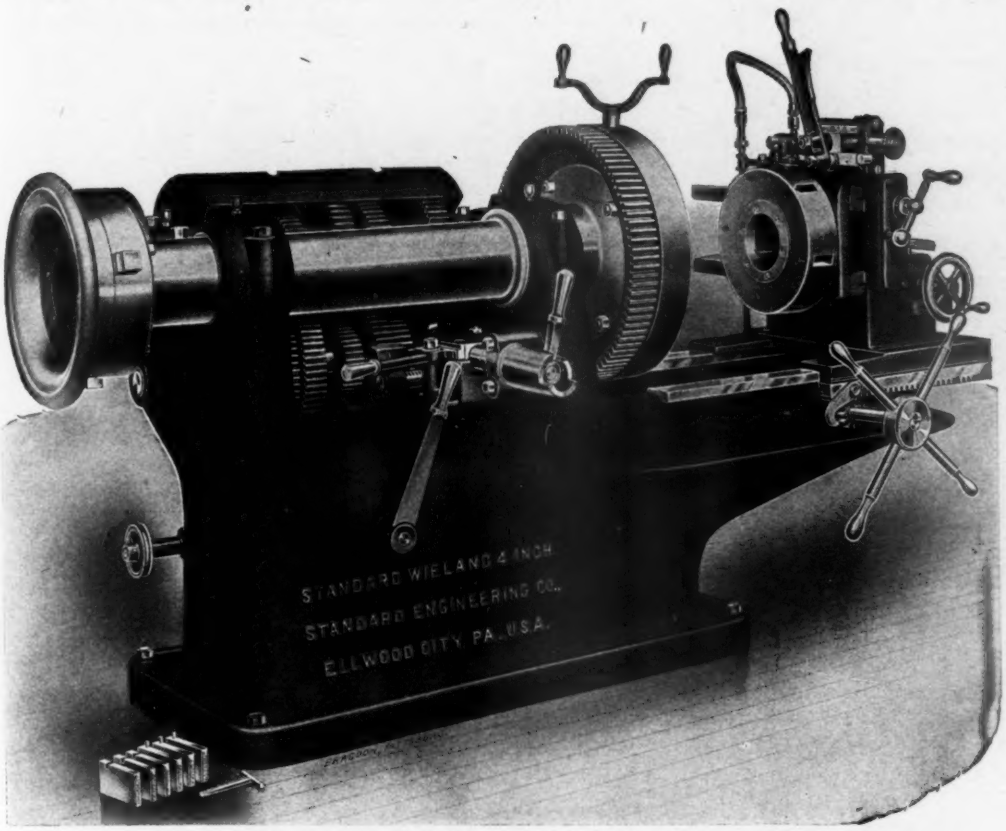
operation is also claimed. The pressure from the larger differential operates both the riveter and the plate closer, the plate closer automatically working in advance of the riveter. By means of the three-way valve E the plate closer can be cut out when not required. The small differential B furnishes pressure to push back the riveter and plate closer. Air pressure acts on this differential at all times but if necessary can be cut off by means of the valve D.

This system which is being patented by Mr. Wm. H. Wood, Hydraulic Engineer, Media, Pa., has been in use for some time operating several machines with excellent results.

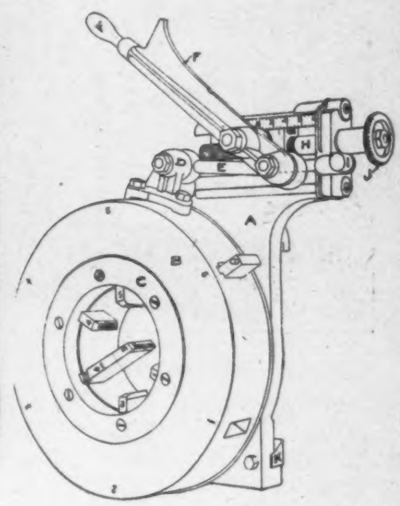
The Cost of Gas vs. Steam Power. Comparisons between operating costs of gas and steam power stations are not often made on a fair basis, but the *Engineering Review* records a comparison of two stations on the same system, operated by the same company, and so situated that the cost of fuel of both is exactly alike. The stations are in Guernsey, one at St. Peterport and the other at St. Sampsons. For the month of October the cost per unit generated was 69.2c. for the gas driven and 103c. for the steam driven plant.

PIPE THREADING AND CUTTING MACHINE.

The 4-in. pipe-threading and cutting machine shown in the photograph is of recent design and embodies a number of important improvements. The construction is substantial, its operation is accurate and powerful and changes in speed or adjustment may be quickly and easily made. The bed is cast in one piece. Six spindle speeds obtained by machine cut steel shifting gears are available. The speed changes may be made while the machine is in motion by means of levers conveniently placed for the operator.



STANDARD WIELAND 4-IN. PIPE THREADING AND CUTTING MACHINE.



WIELAND DIE MECHANISM

DIE OPERATING MECHANISM.

The die operating mechanism is a straight line lever device and as it has no connection with the adjusting screw is not liable to become loose. The adjusting screw H passes through a fulcrum nut or block G. The latter is provided with a clamp gib to make the adjustment positive. Moving the fulcrum block G to the left by means of hand wheel J, which is keyed to adjusting screw H, contracts the chasers radially. The lever F has an arc-shaped fin which rides on its rest and automatically centers the lever and connecting link E in a straight line at all points of adjustment. Grooves cannot be gouged across the threads with this mechanism, as the chasers are withdrawn from the pipe the moment the lever is raised. The cam ring B has an opening opposite each chaser which allows the passageway to be cleaned without removing the ring. The lower chasers, 1, 2 and 3, have a groove and are put into place from the inside of the die-head. The upper chasers, 4, 5 and 6, have projecting pins and are inserted from the outside through holes in the periphery of the cam ring. None of the chasers can drop out of place, and no stop is required on the cam ring. The chasers are unusually deep, and if proper attention is given to keep them sharp, will cut a full thread on any kind of pipe at one cut. Those for 4-in. pipe will, when new, cut a perfect thread or screw end 2 ins. long. This is of advantage in several ways: It enables the cutting of a full taper thread for heavy fittings tapped deeper than standard—the Briggs' standard 4-in. threau being only 1.05 inches long; and it also allows the entrance of the chasers to be ground when necessary and still leave enough depth for a standard thread. The face ring C, through which screws pass to bear it against the front of the chasers, has an interlocking ring fitting into a recess in the bore of the die-head to prevent fine chips from passing through. The die head A may be slid aside before cutting off the pipe or removing it from the machine, thereby preventing the ruining of the bottom chasers by dragging the pipe across them.

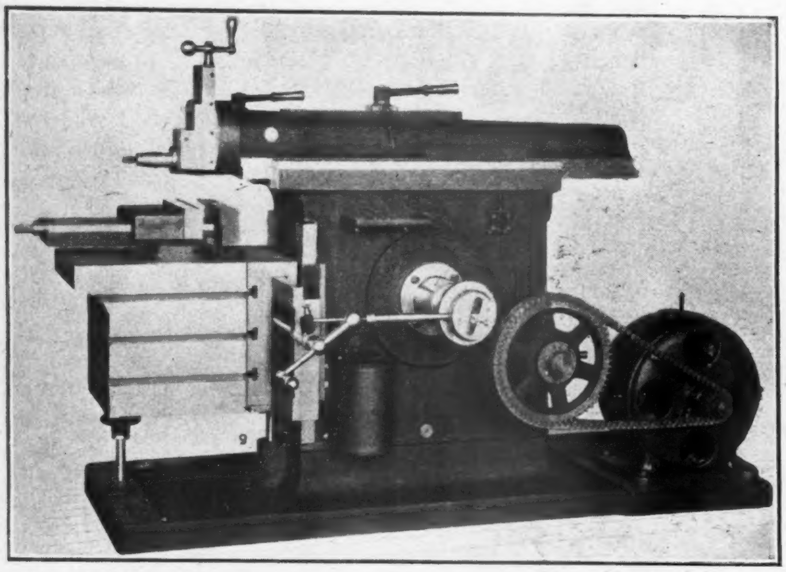
The cutting-off slide is fitted with a lathe tool post; the burr can thus be cut out of the pipe by turning the tool at an angle after the pipe is cut off. The gripping chuck at the front of the spindle is universal; the scroll chuck at the rear is used only for centering the pipe. A rotary pump delivers oil to both the die-head and the cutting-off tool. This machine weighs about 4,000 lbs. and is made by the Standard Engineering Company of Ellwood City, Pa.

MECHANICAL DRAFT.—Referring to this subject the *Engineering Review* (London) in a recent issue, states that: "By such an arrangement the coal consumption may be increased from the 15 to 20 lbs. per sq. ft. of grate possible with chimney-draft to 30 to 40 lbs. per ft. under ordinary conditions, and beyond this amount under special circumstances. This results not only in a proportionate increase of steaming capacity in the boilers, but in a greater efficiency of combustion, and consequent economy. Most steam-boiler plants nowadays are provided with economizers. Where such is the case an opening is made in the flue between the economizers and chimney, and the fan inlet connected thereto by a short brick or metal flue. Another opening is made in the main flue at a point nearer the chimney, or into the chimney itself, and this opening is connected to the fan outlet in the same way as to the inlet. Between the openings, and inside the main flue, is placed a damper, so that all gases after leaving the boilers must of necessity pass through the fan on their way to the chimney, so long as the damper is closed. It is also customary to place dampers both at the inlet and outlet of the fan, so that by manipulating these two and the one in the main flue, the fan may be cut out, and natural draft resorted to in case of necessity. The same arrangement applies where no economizers are installed, and in such cases the fan handles the gases at the high temperature at which they leave the boilers."

AN ANCIENT MAKESHIFT.—A peculiar locomotive which was built in the year 1874 is at present at work at the Coed Taloa Colliery, North Wales. The frame and wheels are the remains of an old coal wagon, and upon this frame has been fixed an old portable engine, the motion of the main shaft being communicated by cog wheels to the axle of the wagon, geared in such a manner as to add considerably to its power. The speed limit is six miles per hour.

MOTOR-DRIVEN SHAPER.

The 25-in. crank shaper illustrated in the photograph is driven through a Morse silent chain by a 3½-h.p. Crocker-Wheeler variable speed motor, which is mounted on an extension of the base at the rear of the machine. The back gears, which are operated by a lever at the rear, and the variable speed motor afford a range of speeds of from 6 1-3 to 44 strokes per minute. The motor controller and switch are placed on the side of the column within easy reach of the operator.



MOTOR DRIVEN CRANK SHAPER.—JOHN STEPTOE SHAPER COMPANY.

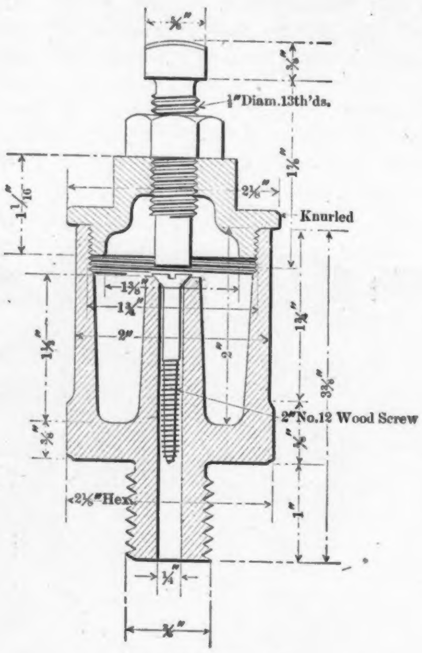
The feed mechanism and the crank for adjusting the length of the stroke may readily be adjusted by the operator from his position in front of the machine. The top of the table measures 16 by 25 ins. It is slotted on three sides and can easily be removed, thus allowing work to be fastened to the slotted apron to which it is attached. The table has an automatic cross feed of 27½ ins. and a vertical adjustment of 14 ins. An opening under the ram will admit shafts as large as 3½ ins. in diameter for cutting keyways.

The lever at the rear of the graduated head allows it to be loosened and swiveled to any angle and instantly fastened in place. The tool head has an adjustment of 9 ins. All feeds are automatic and can be adjusted while the machine is in motion or at rest. The vise is graduated and can be swiveled to any angle desired. The jaws are of steel, 2¼ by 12 ins., and can be separated to take work as wide as 15 ins. This shaper is manufactured by the John Steptoe Shaper Company of Cincinnati, Ohio.

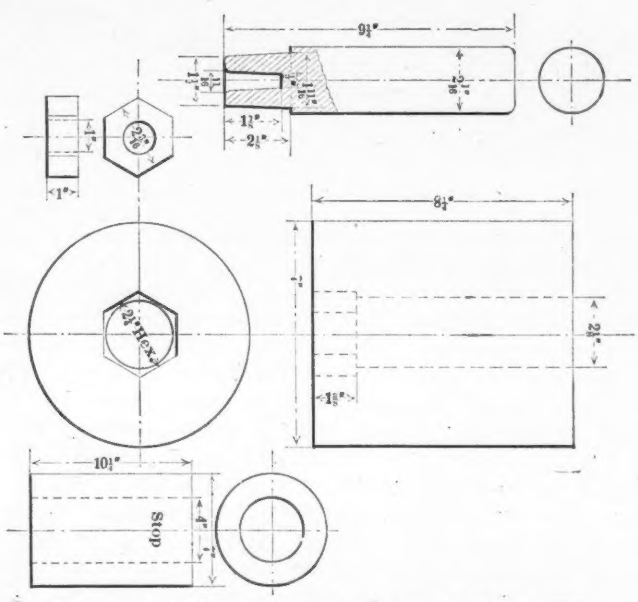
Air Openings Under Locomotive Grates.—If it is desired to determine whether or not the amount of damper opening is sufficient on an engine which is in service, multiply the coal burned per minute by 18, and divide the result by .07, which gives us the cu. ft. of air required per minute. (The authors present curves for obtaining the area required to pass this volume.) In comparing engines of the older classes with those of to-day, we find that the damper opening has been gradually reduced; while on the little old engines of the past it was ample and figured close to what it should be by the method proposed above, the space for damper opening is scarce on some of the later types of locomotives. As there is a direct loss of heat where the air supply is not adequate, sometimes reaching 25 per cent., it shows us that this ashpan subject is one which should not be forgotten in designing a new locomotive, or improving one which is in service, and it is safe to say that a large saving in fuel can be accomplished by increasing the damper openings in our recently built locomotives.—*Messrs. Kinsell, Lynch and Shepard, before Northwestern Railway Club.*

WROUGHT IRON SIDE-ROD OIL CUPS.

We have received drawings of wrought iron side-rod oil cups, together with the punches and dies used in making them. These cups are made under a steam hammer and at one blow.



SIDE ROD OIL CUP.



DIES FOR MAKING WROUGHT IRON SIDE-ROD OIL CUPS.

They are very satisfactory in service and much cheaper than the brass cups ordinarily used; they overcome the weakness of the brass cups at the bottom of the strap fit. These cups are in use on a well known railroad, and the idea seems to be an excellent one.

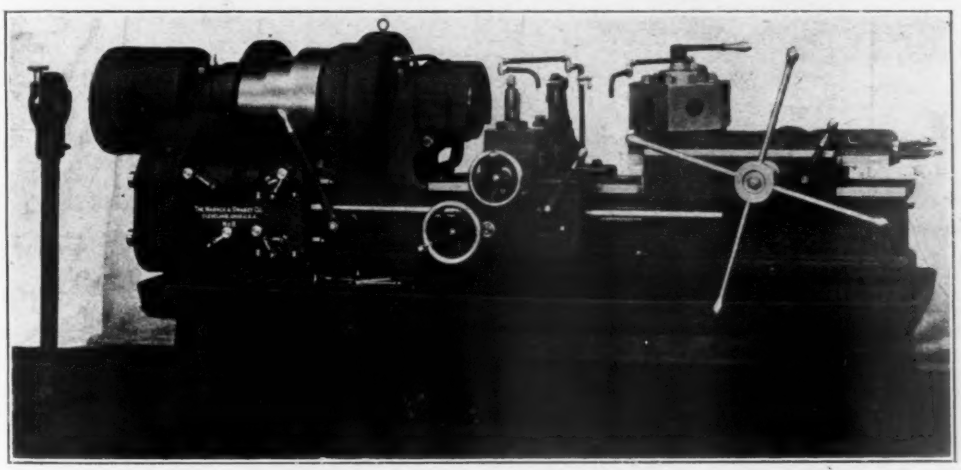
Gas Producers vs. Boilers.—The most economical boiler is as efficient as the most economical gas producer, but in daily practice the advantage would be on the side of the latter. The maximum efficiency of each is about 85 per cent., but for everyday work the steam boiler would not average more than 60 to 65 per cent., and the gas producer 65 to 70 per cent. But the greatest economy is in the gas engine itself, which, according to public tests, exceeds in thermal efficiency the best figures for the steam engine by about 65 per cent.—*J. H. Hamilton, before South Staffordshire Iron & Steel Institute.*

NEW TURRET SCREW MACHINE.

The head and bed of the turret screw machine, shown in the photograph, are cast in one piece, to insure strength and rigidity. It has a 20-in. swing over the bed, and is equipped with an automatic chuck, which will take bar stock of any shape up to 3⅝ ins. in diameter. The turret slide has 14 ins. travel. Twelve spindle speeds, from 15 to 156 r.p.m., are provided. The back gears are thrown in and out by means of friction clutches. A 4-in. driving belt is used.

A system of compound levers, operated by the long lever in front of the head, gives a powerful movement for closing the jaws of the automatic chuck; the same lever also engages and disengages the power roller feed. The turret slide is provided with a supplementary taper base, by means of which the center of the tool holes in the turret can be adjusted to the exact height of the center of the spindle. Taper gibs, fitted the whole length of the saddle on each side, provide means of adjusting the slide sideways. The slide is equipped with a geared automatic feed, with four changes in either direction.

The turret is hexagon in form, has six tool holes 2½ ins. in diameter, and also bolt holes for attaching the tools to the faces. It is so arranged that any stock smaller than the diameter of the tool holes can pass entirely through it. The index is nearly the full diameter of the turret, and the lock bolt is placed directly under the working tool. Independent adjustable stops are provided for each face. The carriage has a geared automatic cross feed with four changes, and a hand longitudinal feed. In addition to the tool post provided for forming and turning tools is a holder for cutting off tools. The turret and carriage feeds are independent of each other, and are both provided with adjustable automatic trips. All feeds are geared, and can instantly be changed by means of levers.

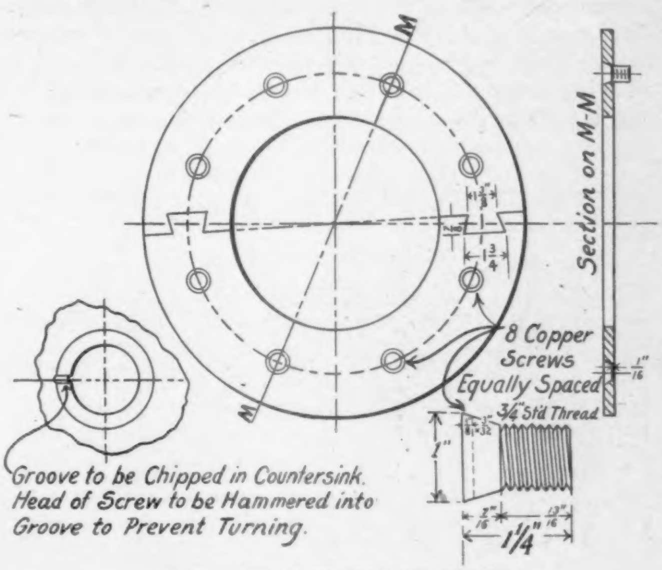


NEW TURRET SCREW MACHINE—WARNER & SWASEY COMPANY.

A geared pump delivers oil to the cutting tool for both the turret and the carriage through two systems of piping. The pump operates when running in either direction. A motor drive can readily be applied to the machine if desired. The weight of this machine, which is made by the Warner & Swasey Company, Cleveland, Ohio, is about 6,000 lbs.

GOOD DEVICE FOR SECURING HUB LINERS.

Among many crude methods of securing hub liners there is an occasional good one. This engraving illustrates a simple one used with satisfaction by the Boston & Maine for years. Copper screws with countersunk heads are used. After the holes in the liners are countersunk a groove is cut along the countersunk surface with a small round-nosed chisel. By leaving a little surplus material in the heads of the copper screws they are hammered down as in riveting and the copper forced into the groove. This forms an effective resistance to the loosening of the liner, as the screws cannot turn backward because the "feather" on the head of the screw prevents it from moving. This drawing was received from Mr. H. O. Keay, chief draftsman of the motive power department of the road.



DEVICE FOR SECURING HUB LINERS.

Incandescent Lamps.—When Edison first made the small incandescent electric lamps, consisting of a carbon filament fixed by platinum wires in a pear-shaped glass bulb, from which the air had been exhausted, the cost was $3 each; now there are many million similar lamps of better quality made each year and sold at less than 20 cents each.—*Mr. Alex. E. Outerbridge, Jr., Am. Academy of Political and Social Science.*

The available coal supply in England is estimated at 100,914 million tons, which will meet the demands for the next 400 years.

Development of the Gas Engine.—Since the manufacturers of the gas engines guaranteed an effective horse power by the consumption of 18 cu. ft. of gas of 135 calories (the usual quality of city gas), the use of the engines has multiplied rapidly. In German cities from 15 to 25 per cent. of the total output of the gas works is supplied for operating gas engines, while in Paris something like 5 per cent. of the total output is utilized in this way. There are few, if any, American cities where even 1 per cent. of the gas output is used for operating gas engines. However, the steady development of the industry indicates that changes in this respect may be expected, and that in cities where gas is supplied at $1 or less per 1,000 the gas engine will become an important factor in the industrial life of the near future.—*G. E. Walsh, in Western Electrician.*

Fire Tests of Automatic Sprinklers.—Recent tests were made in the car barns of the Public Service Corporation of New Jersey to show the efficiency of automatic sprinklers. Three cars were fired. In all three cases the fire was confined to the car in which it originated. The first opened 10 sprinklers, and was extinguished in 18 minutes after the first one opened. The second opened 11, and was out in 2¼ minutes after the first one opened. The third, using oil over the entire interior of the car, opened 10, and was out in 4¼ minutes after the fire was started. This test showed that the hottest fire was the easiest to put out.

AN IMPROVED UPRIGHT DRILL.

A positive feed mechanism is essential if the maximum efficiency is to be obtained from drilling machines using high speed drills. The feed changing mechanism must be placed within easy reach of the operator and the changes must be such that they may be made easily and quickly. The Cincinnati heavy pattern upright drill shown in Fig. 1 is equipped with the positive geared feed mechanism shown in detail in Fig. 2. By means of the quick change feed box on the sliding head convenient to the operator any one of six feeds (.006, .009, .013, .018, .027 and .039 ins. per revolution of the spindle) may instantly be obtained. The feed in use is plainly shown on the index.

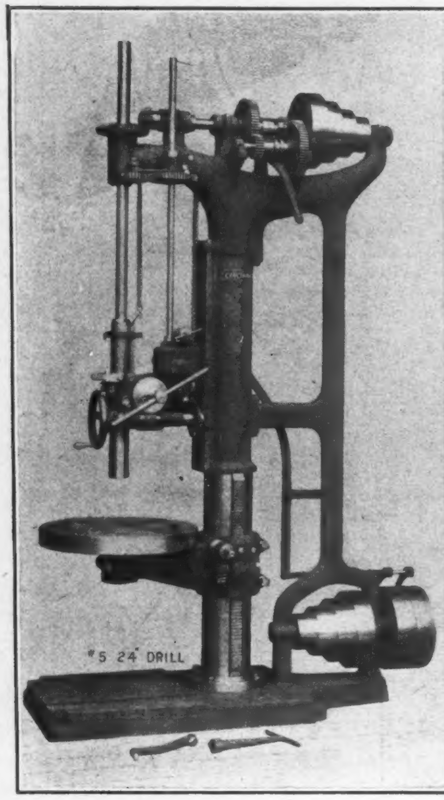


FIG. 1.
STANDARD UPRIGHT DRILL WITH POSITIVE FEED.

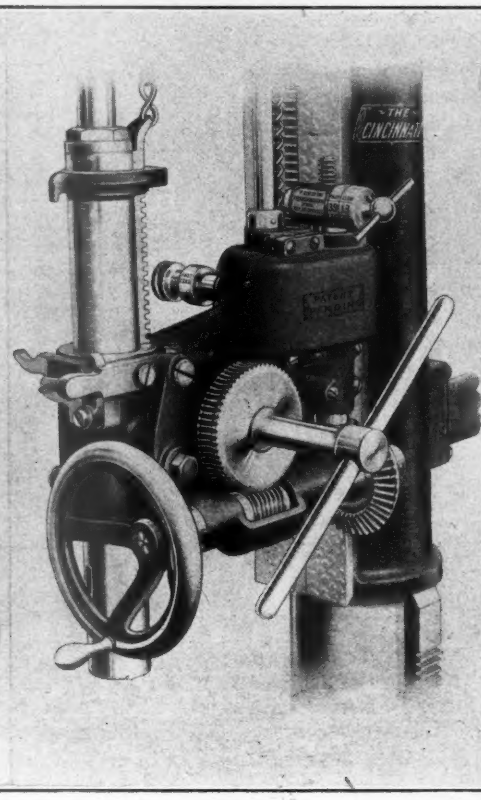


FIG. 2.
POSITIVE FEED MECHANISM.

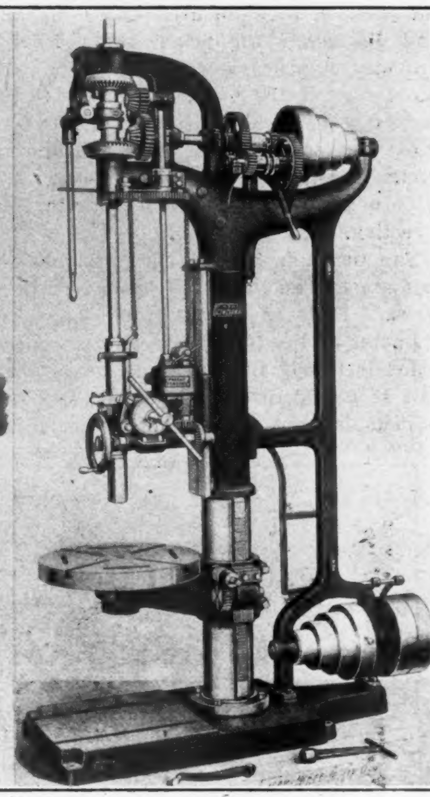


FIG. 3.
UPRIGHT DRILL, WITH POSITIVE FEED AND GEARED TAPPING ARRANGEMENT.

CINCINNATI MACHINE TOOL COMPANY.

The upright drill shown in Fig. 3 is equipped with the positive feed mechanism and also with a patent geared tapping arrangement which is placed on the drill spindle and is operated by the long lever which hangs parallel to the spindle. By means of this lever, which controls a double clutch, the operator may start, stop or reverse the motion of the spindle without using the shifter. The clutches may be engaged or disengaged while the machine is in motion, thereby allowing the operator to drill a hole, remove the drill and substitute a tap and tap the hole without stopping the machine. The spindle has a quick reverse speed of 2 to 1.

These machines are made in 24, 28, 32, 36 and 42-in. sizes by the Cincinnati Machine Tool Company of Cincinnati, who make a strict specialty of upright drills.

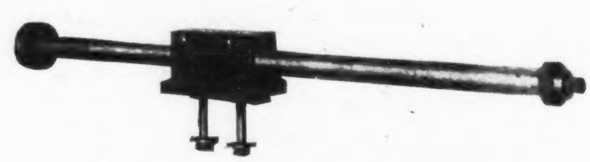
THERMAL STORAGE FOR LOCOMOTIVES.—Mr. Druitt Halpin's system of heat storage has been applied to a locomotive boiler of the Great Northern Railway of England. A cylindrical storage tank is placed on top of the boiler, to which it is connected by means of a pipe. The feed water, heated to the same temperature as that of the boiler, is passed through this cylinder, the heating being done by steam taken from the boiler when the engine is standing or the safety valves are blowing. In this way a large supply of heat is available to help the boiler when running. In stationary practice a test by Professor Unwin has shown a coal saving of 19 per cent. with this system.

A HOME-MADE INTERNAL SURFACE GRINDER.

In boring or reboring steel tubes, hydraulic jack barrels, or other wrought iron or steel cylinders, where accuracy and smoothness of bore are essential, it is often impossible to obtain satisfactory results by machining with the ordinary boring tools. In an attempt to overcome the difficulties, caused by tool marks, of roughness from chattering and of taper bore, in hydraulic cylinders, the interesting little grinding appliance, here shown and described, was designed by Mr. L. L. Smith, M. E.

The device consists of a ¾-in. diameter steel shaft, which is enclosed within and arranged to revolve inside a steel tube of 1 in. inside diameter and 40 ins. long. The shaft is supported and given bearing by bronze bushings pressed into the ends of the tube. One end of the shaft carries an emery wheel, which may vary in diameter from 2 ins. upward, according to the character of the work required; the other end carries a driving pulley for a 1 in. belt.

The grinder is bolted on the carriage of an ordinary engine lathe, with the axis of the grinding shaft carefully paralleled



INTERNAL SURFACE GRINDER FOR ORDINARY LATHE.

to the center line of the lathe, by means of the clamp-block shown in the engraving. The cylinder or tube to be finished by grinding is set up and centered in the lathe, with one end in the cauck and the outer end supported by a steady rest. The cylinder is rotated slowly by the lathe in one direction of rotation, while the emery wheel is driven at about 3,500 r. p. m. in the opposite direction from an overhead drum. The grinder is fed back and forth in the cylinder until the desired finish is obtained.

This device is valuable for smoothing the inside surface of

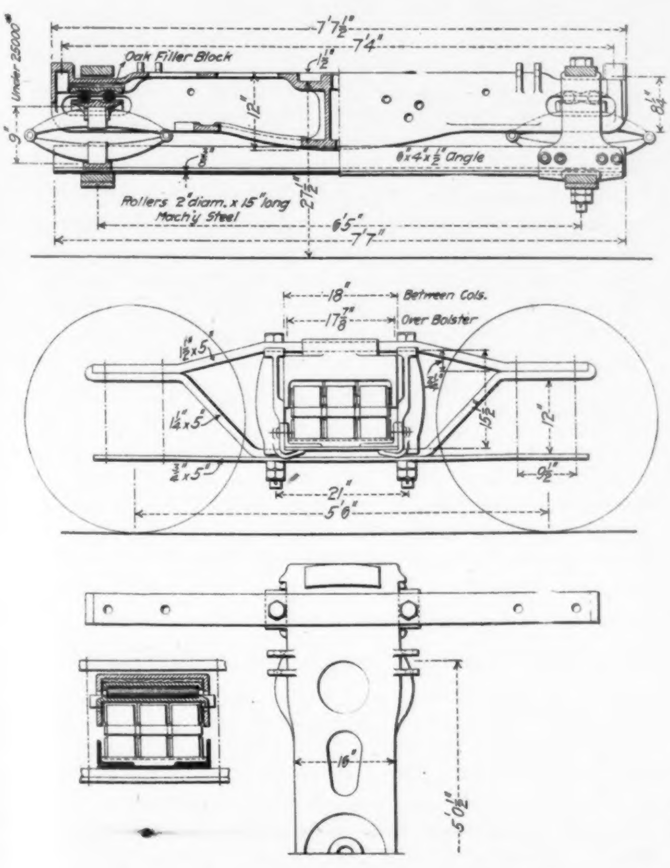
rough wrought iron pipe to render it suitable for air hoist or air jack purposes. It is also well adapted to the internal grinding of a large variety of small work, such as hardened bushings, collars, etc. It is a very effective tool and is one that can be used to great advantage in any machine shop.

BARBER TENDER TRUCK.

CHICAGO, ROCK ISLAND AND PACIFIC RAILWAY.

The type of truck construction developed by Mr. J. C. Barber, of the Standard Car Truck Company, Chicago, is a noteworthy success in the severest service in the country. It provides side motion for the bolsters by means of rollers and involves a principle which is becoming exceedingly important in connection with the breakage of flanges of cast iron wheels under cars of large capacity.

A recent application of this type to the trucks of 7,000-gallon tenders on the "Rock Island" is illustrated in the accompanying drawing. This is an ingenious combination of elliptic springs, rollers, a cast steel truck bolster and a low arch-bar truck. The problem was to get the rollers into a combination



BARBER TENDER TRUCK.—CHICAGO, ROCK ISLAND & PACIFIC RAILROAD.

of this kind without thinning the ends of the bolster too much and yet to keep the parts low enough for the available space.

It was accomplished by combining the lower roller seat and upper spring seat in a casting provided with lips to enclose the columns and by providing slotted openings through the ends of the bolster for these castings to pass through. The arrangement provides for the springs under the hollow bolster and the rollers are inside the bolster, the effect being to thin the bolster ends down to a single thickness of cast steel sufficient for the upper roller seat to bear against, and yet there is no sacrifice of strength of the bolster. This is clearly indicated in the engraving. These trucks are reported to be very satisfactory in service.

IDEAS IN MOTION.—You have all had ideas and you will have more of them. These mental forces, like other forces, only do work when in motion. Hence your ideas are only valuable when put into execution, and this often requires more talent than to originate them. Some men seem to consider their ideas so good that they will execute themselves.—*Walter C. Kerr.*

"I have been a close observer of successful men, and few do more than sprout, up to the age of thirty-five; and if by that time they have builded well and upon a sure foundation, their chances for success are more than even. Setbacks, disappointments and mistakes are frequently the making of men. Uninterrupted success, as a rule, is dangerous.—*Francis H. Peavey.*

OPPORTUNITIES.—We hear much about opportunities. They are everywhere plentiful. Remember that your opportunity is the little one that lies squarely in front of you, not the large one which you hope to find further along. Many a man is surrounded with opportunities who never seizes one. There are traditions that Adam, William Tell, and Sir Isaac Newton each had an affair with an apple, but with different results.

WALTER C. KERR.

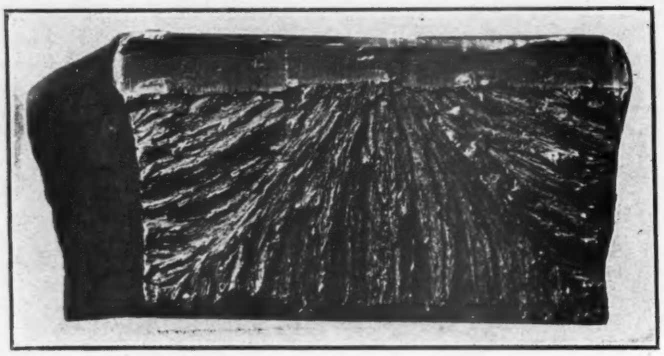
ENCOURAGEMENT IN PROMOTIONS.—Every man should be encouraged. Believe that he can do better things than he is now doing or that he can do the things he is now doing in a better way and with advantage to himself. Every promotion should be with the prime idea of strengthening the machine, of making the organization stronger—more capable. The promotion should be made, not only to supply a place with a needed piece of material, but to so fill that place that the setting will be complete and harmonious, that the selection and promotion will be approved of men.—*W. R. Heath, before Central Railway Club.*

PRODUCTION IMPROVEMENTS.—To show the difference in cost where different machinery or improved processes are used. For making one hundred ¾-in. by 4-in. hexagonal head finished bolts, on a modern turret lathe, by reducing the body of the bolt from a commercial bar of hexagonal steel of a size required for the head, the cost is $15.84. Similar bolts are now made by a machine-screw company by welding electrically the head (cut from a bar of hexagonal steel) to the body of the bolt, made from a piece of cold rolled steel the exact diameter of the bolt, and sold for $5.88, which shows a saving in favor of this process of approximately 63 per cent.—*Mr. Alex. E. Outerbridge, Jr., Am. Academy of Political and Social Science.*

CHEAP POWER FROM PRODUCER GAS.—The cost of running engines with producer gas is, in fact, so low that installations are being laid down in Grenoble, where an enormous capital has been spent upon the creation of hydro-electric plants. It was expected that the price at which electrical energy could be supplied by the huge plants in the Dauphine would allow of electricity supplanting every other form of motive power throughout the entire district. This price has been still further cut by producer gas. A few instances of working cost may be interesting. One user states that the fuel consumption for an 8-h.p. engine amounts to $1.31 for 64 hours; in another case the total working cost for a 22-h.p. engine is 80 cents a day; while a 22-h.p. oil engine, costing $2.80 a day, was replaced by a 25-h.p. engine running with producer gas, and the daily expense was reduced to 60 cents. In these cases Anzin coal or anthracite was employed. These results are so striking that producer gas plants are attracting considerable attention in France, where good fuel is not procurable except at a high figure, and further trials with the Pierson suction plant are to be carried out shortly by the French Institute of Gas Engineers, at which trials it is probable that the British Institution of Gas Engineers will be represented.—*The Engineer, London.*

A NEW ANTI-FRICTION METAL

A new feature in the line of anti-friction metals is shown in the photograph which illustrates a piece of metal which has been nicked on one side and after being placed in a vise has been broken off by a sharp blow from a heavy hammer. A fibrous and stringy mass is revealed. The alloy is of a tin and aluminum base and the fibers always radiate from the chilling surfaces, regardless of the number of times it is reheated, thereby presenting the ends of the fibers to the wearing surfaces and thus increasing its wearing capacity and its ability to resist crushing. The metal is very tough and its texture is fine and smooth with no granular matter intervening. Under the most severe tests and shocks it does not become brittle. It may be remelted an indefinite number of times without becoming hard or losing any of its original properties, and is especially adapted for use in the linings of



A NEW ANTI-FRICTION METAL, SHOWING FRACTURE.

driving box and engine truck brasses, eccentric straps, crosshead gibs, steam and gas engine bearings, wood working and all kinds of high speed machinery.

This metal, together with some new bronzes and a "copper-steel," or hardened copper composition, will be placed on the market by the Buda Foundry & Manufacturing Company of Chicago, who will in the future make this an important branch of their increasing business which in the past has been largely confined to track supplies.

The thermal efficiency of gas engines is about double that of the best steam engine of the same power, which means that if fuel in the form of a gas could be obtained equally as cheap in proportion to the heat produced as that in coal, gas engine power would cost only one-half of that of steam engine power. Engines of this type are made so as to burn cheap oils or gas made from the vaporization of oil directly in the cylinder, and certain types of this class of engines are in extensive use. A cheap form of gas known as producer gas can be made in a producer from coal. The producer would probably have an efficiency of about 60 per cent. or 20 per cent. less than a steam-boiler. This producer gas could be burned in a gas engine giving an efficiency of probably 30 per cent., so that we should have a joint efficiency of about 18 per cent., which is probably 50 per cent. better than has ever been done in a steam engine.—*Prof. R. C. Carpenter, in Power and Transmission.*

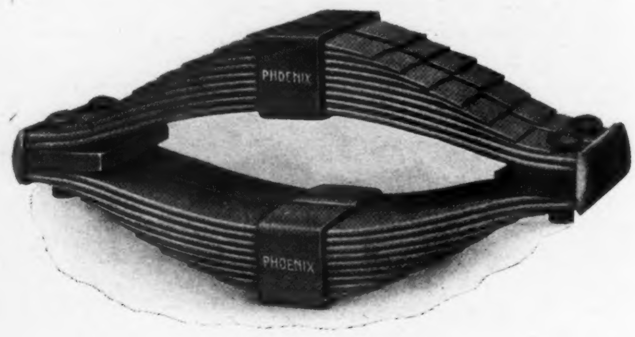
Sustained high speed is a matter of finance.—*F. J. Sprague.*

Mr. W. P. Sproul has been appointed master mechanic of the Atlantic Coast Line, with headquarters at Savannah, Ga., to succeed Mr. F. S. Anthony, resigned.

Mr. J. F. Deems.—The jurisdiction of Mr. Deems, general superintendent of motive power, rolling stock and machinery of the New York Central Lines, has been extended over the Michigan Central and the Cleveland, Cincinnati, Chicago & St. Louis, thus adding to his already great responsibilities those of 1,000 locomotives and 37,000 cars, running on 3,600 miles of track.

PHOENIX IMPROVED TENDER SPRING.

This spring, of which a double elliptic is illustrated, is provided with end plates and connections arranged for easy assembling and repairs. Instead of using eyes or scrolls at the ends of the plates with a connecting bolt, which necessitates a curved neck in the end of the leaf, the ends of the halves are connected by malleable rockers, which retain the springs in their proper relative positions. Their longitudinal end pockets and central flanges confine the ends in alignment, preventing twisting, and providing seats for the ends of the



A NEW TENDER SPRING.

halves, over which the springs may move easily when elongated or contracted by changes in loading. With light loads or no loads the bearing is at the extreme ends, and when compressed on the rocker castings the springs are shortened, and the bearing is increased in proportion to the load. If a leaf in any section breaks the section is easily removed and a new section, from stock, is quickly put in place, without requiring the services of a special machine to make a scroll on a new one. These malleable rockers are adapted to any desired number of halves. These springs require no forging which tends to weaken the metal. They are guaranteed for a service of two years. These springs are manufactured by the Phœnix Car Spring Company, Rookery Building, Chicago, Ill., from whom they may be obtained in any desired size.

Making Precedents.—A man who has learned by experience to do a thing deserves no credit for doing it right. He is then only a repeating machine. Real power is characterized by ability to perform right the first time that which a man never did before.—*Walter C. Kerr.*

TWO PRESSURES FROM ONE COMPRESSOR.

By means of the new "skip" valve introduced by the Norwalk Iron Works Company, pressure of from 80 to 100 lbs. for operating pneumatic tools, and 20 to 25 lbs. for sand blasting, painting, etc., are taken from the same compressor, and these pressures are automatically maintained. These valves are used as the inlet valves of the second cylinders of two stage compressors, and the low pressure mains are supplied from the intercooler, between the two stages of compression. If the pressure in the intercooler falls below a predetermined point, the skip valves remain open, and the second cylinder rejects its supply of air, throwing it back to the intercooler. The skip valve automatically adjusts the amount, remaining open any number of revolutions, or only part of a revolution, as required. The speed and pressure governors regulate the speed of the machine to meet the demands of both high and low pressure systems. With these arrangements, any quantity of air within the limits of the machine may be drawn off at any time, and the speed is automatically adjusted to suit. This avoids the necessity for operating two compressors and reducing valves if but one compressor is employed. Further information concerning this interesting improvement may be had from the manufacturers, who may be addressed at South Norwalk, Conn.

PERSONALS.

Mr. L. J. Miller has been appointed master mechanic of the Missouri Pacific, with headquarters at Atchison, Kan.

Mr. Maurice Prendergast has been appointed general foreman of the shops of the Baltimore & Ohio at Fairmount, W. Va.

Mr. W. A. Stearns has been appointed assistant master mechanic of the Louisville & Nashville at Louisville, Ky.

Mr. R. H. Rogers has been appointed master mechanic of the New York, New Haven & Hartford Railroad at South Boston, Mass.

Mr. C. G. Arthur has been appointed master mechanic of the Southern Railway at Columbia, S. C., to succeed Mr. J. F. Sheahan.

Mr. W. E. McEldowney has been appointed master mechanic of the Denver, Enid & Gulf Railroad with headquarters at Enid, Okla.

Mr. F. A. Beckert has been appointed master mechanic of the Louisville & Nashville, with headquarters at Knoxville, Tenn.

Mr. A. C. Hinckley has been appointed master mechanic of the Cincinnati, Hamilton & Dayton at Lima, Ohio, to succeed Mr. J. E. Gould.

Mr. W. L. Tracy has been appointed master mechanic of the Louisville Terminals of the Louisville & Nashville Railroad at Louisville, Ky.

Mr. Albert Nugent has been appointed master mechanic of the Spokane Falls & Northern, with headquarters at Spokane, Wash., to succeed Mr. C. H. Prescott.

Mr. H. H. Kendall has been appointed superintendent of motive power of the St. Louis, Brownsville & Mexico Railway, with headquarters at Kingsville, Texas.

Mr. E. G. Haskins has been appointed master mechanic of the Denver & Rio Grande with headquarters at Salida, Col., to succeed Mr. A. C. Hinckley.

Mr. F. R. Cooper has been appointed master mechanic of the Georgia, Florida & Alabama, and the Carrabelle, Tallahassee & Georgia, with headquarters at Bainbridge, Ga.

Mr. George Wagstaff has been appointed supervisor of boilers of the Vanderbilt system, with office at Buffalo, reporting to the general mechanical engineer, Mr. F. M. Whyte.

Mr. F. Mertsheimer has resigned as superintendent of motive power of the Denver & Rio Grande to succeed Mr. C. H. Cory as superintendent of motive power of the Cincinnati, Hamilton & Dayton, with headquarters at Lima, O.

Mr. C. E. Boss has been appointed acting master mechanic of the Ft. Worth & Rio Grande and the St. Louis, San Francisco & Texas Railways, with headquarters at Sherman, Tex., to succeed Mr. H. C. McKelvey, resigned.

Mr. W. A. Johnson has been appointed general foreman of machinery and equipment of the Manistee & Grand Rapids Railway with headquarters at Filer City, Mich. He was formerly master mechanic of the Iowa Central.

Mr. M. D. Franey has been appointed superintendent of shops of the Lake Shore & Michigan Southern Railway at Collinwood, Ohio. He was formerly general foreman of the Michigan Central shops at Jackson, Mich.

Mr. B. A. Worthington, assistant director of maintenance and operation of the Harriman Lines, has been appointed general manager of the Oregon Railway & Navigation Company, with headquarters at Portland, Ore.

Mr. H. C. Bayless has been appointed mechanical engineer of the Minneapolis, St. Paul & Sault Ste. Marie, with headquarters at Minneapolis, Minn.

Mr. Alfred Lovell, heretofore assistant superintendent of motive power of the Atchison, Topeka & Santa Fe Railway, has been appointed superintendent of motive power, with headquarters at Chicago, Ill.

Mr. A. W. Wheatley, general master mechanic of the Northern Pacific, has resigned to accept the position of superintendent of shops of the Chicago, Rock Island & Pacific at East Moline, Ill. The appointment of a man of Mr. Wheatley's attainments in charge of a shop plant indicates the importance in which the operation of a large and expensive plant is held by the management of this road. It is to be hoped that this appointment marks a new era in railroad shop management.

Mr. T. R. Brown has been appointed engineer of steel car construction of the American Car and Foundry Company, with headquarters in New York. He is widely known as formerly master mechanic of the Juniata shops of the Pennsylvania Railroad at Altoona, later as works manager of the Westinghouse Air Brake Company, and general manager of the Corrington Air Brake Company. Mr. Brown is eminently well fitted for his present position, where he can bring to bear in matters of car design, experience in building locomotives and cars, and wide manufacturing experience, supplemented by intimate knowledge of railroad conditions.

BOOKS.

Poor's Manual of Railroads.—The Railroad Manual Appendix, containing the fifth annual compilation of Poor's Ready Reference Bond List has been issued. It brings up to date tables of dividends and annual meetings, stock registrars and transfer agents. In addition to the appendix a revised statement of the Rock Island system has been received. This is revised to June 30, 1904, and is to take the place of the statement appearing on pages 756 and 757 of Poor's Manual for 1904.

Traveling Engineer's Association. Proceedings of the Twelfth Annual Convention. Edited by W. O. Thompson, secretary, Oswego, N. Y.

This volume contains the reports, papers and discussions of the convention held in Chicago in September, 1904. Conspicuous among the subjects are, the selection, training and examinations of firemen, water tube boilers, valve motion, the high speed brake, headlights, the four-cylinder balanced compound locomotive, the last mentioned subject being introduced in paper by Mr. W. J. McCarroll of the Baldwin Locomotive Works. This volume also contains the constitution, by-laws and list of members of the association.

Fowler's Mechanical Engineer's Pocket Book, 1905. By W. H. Fowler. London, Scientific Publishing Company. Leatherette, 500 pages, pocket size. Price, 1s. 6d.

This edition includes substantial improvements over previous ones. It contains a new section on entropy and its appliaction to steam engine practice and this subject is well treated to suit the needs of ordinary students. The additions fill 50 pages, including a number of useful tables and information concerning steam turbines and high speed tool steel, every grinding, milling, reaming and other machine tool subject. The book has been entirely revised and amended to keep it up to current practice. It is a useful book.

The New York Subway: Its Construction and Equipment. Published by the Interborough Rapid Transit Company, 150 pages, 10 by 14 inches in size, profusely illustrated, boards, New York, 1904.

This fine record of the Subway is a fitting tribute to the men who have successfully carried this remarkable enterprise to completion and operation.

The introduction is historical, Chapter I gives the route of the road and location of stations, also photographs and plans of typical stations. Chapter II presents types and methods of construction and illustrates the difficulties encountered. Other chapters deal in detail with the powerhouse, the power plant, the system of electrical supply, electrical equipment of cars, lighting system for stations and tunnels, cars and tracks, signal system, drainage, repair

sheds and the closing chapter gives the names of the sub-contractors. The letter press and engravings are beyond criticism and great credit is due the McGraw Publishing Company, under whose direction the volume was prepared. The book is worthy of the great work which it so satisfactorily records.

NEW CATALOGUES.

IN WRITING FOR THESE CATALOGUES PLEASE MENTION THIS PAPER.

CHUCKS.—Catalogue A, from the Westcott Chuck Company, Oneida, N. Y., describes the lathe and drill chucks made by them.

SHAPERS.—A circular from the Queen City Machine Tool Company of Cincinnati, Ohio, describing their new 24-in. back geared crank shaper.

ELECTRICAL SUPPLIES.—A general catalogue of 593 pages and also a smaller edition known as the railway catalogue and devoted to supplies for street railways from the Western Electric Company, 463 West street, New York.

ROLLER BEARINGS.—Bulletin No. 117 from the Hyatt Roller Bearing Company of Harrison, N. J., describes their roller bearings as adapted to shop cars, trucks, cranes, trolleys, tumbling barrels and all work involving heavy duty at slow speed.

TESTING MACHINES.—The Riehle Bros. Testing Machine Company, Inc., 1424 N. Ninth street, Philadelphia, Pa., are sending out supplementary sheets for their Catalogue A. These describe several of their new machines.

WHY DOES A DOG WAGGLE HIS TAIL?—A brochure pointing out certain important features in the design of the "Precision" boring, drilling and milling machine and the power forcing press made by the Lucas Machine Tool Company of Cleveland, Ohio.

BALL AND ROLLER BEARINGS.—Catalogue No. 11 from the Standard Roller Bearing Company, Forty-eighth street and Girard avenue, Philadelphia, Pa., describes and illustrates applications of the various types of ball and roller bearings made by them.

COAL AND ASH HANDLING PLANT.—Bulletin A, issued by the Jeffrey Manufacturing Company, Columbus, Ohio, presents an interesting illustrated description of the method of handling coal and ashes at the power plant of the Scioto Valley Traction Company, Reese's Station, Ohio.

WATTMETERS, AND HOW TO READ THEM.—Folder No. 4032, from the Westinghouse Electric & Manufacturing Company of Pittsburg, Pa., illustrates and briefly describes the construction of their integrating wattmeters and tells how to read them. Various types of the Sawyer-Man incandescent lamp are also illustrated.

STEAM TURBINES.—Catalogue 7002 from the Westinghouse Machine Company, East Pittsburg, Pa., very completely describes the principles and construction of the Westinghouse-Parsons steam turbine and considers its commercial and economic features. A graphical method of showing steam turbine economy and a few typical efficiency tests are presented.

NOTES.

NORTHERN METALLIC PACKING.—The Robinson & Cary Company of St. Paul, Minn., has been appointed exclusive representatives for the Northern Metallic Packing Company.

RUBBER HOSE PRESERVATIVE.—Mr. G. S. Wood, 209 Great Northern building, Chicago, Ill., has received an order from the Tasmanian Government Railways for "P. & W." rubber preservative for coating the air brake hose on that road. This material is very favorably spoken of by those who have used it.

CROCKER-WHEELER COMPANY.—Chas. W. Cross, formerly of the Roberts & Abbott Co., of Cleveland, Ohio, and later electrical engineer for the Eastern Ohio Traction Company, has entered the employ of Crocker-Wheeler Company, of Ampere, N. J., and is attached to the Cleveland office of the company at 816 New England building.

BUDA FOUNDRY & MANUFACTURING COMPANY.—This company has recently increased the facilities of their Eastern branch, which is located in the Havemeyer building, New York City, and in the future will carry a complete line of their track goods for the convenience of buyers. Mr. Robert Spencer has been appointed their Eastern sales manager and will have full charge of the offices. The main offices of the company are in Chicago.

THE FROST RAILWAY SUPPLY COMPANY.—In order that there may be no confusion or conflict with previously organized companies using the name "Monarch" the name of the Monarch Railway Supply Company has been changed to the Frost Railway Supply Company, of which Mr. Harry W. Frost is president, the temporary offices being in the Majestic Building, Detroit, Mich.

CROCKER-WHEELER ANNUAL CONVENTION.—The annual convention of the officers and branch managers of the Crocker-Wheeler Company took place at the main office and works, Ampere, N. J., January 26, 27 and 28. Managers and representatives from all parts of the country were unanimous in predicting a prosperous year in the field of alternating current generators and direct current generators and motors. On the evening of the 27th a banquet was held at the Cafe Martin in New York, at which the president of the company, Dr. Schuyler Skaats Wheeler, presided.

ROUNDHOUSE HEATING AND VENTILATION.—The Blair Furnace roundhouse of the Pennsylvania Railroad at Altoona, Pa., is equipped with a large steam hot blast apparatus constructed by the B. F. Sturtevant Company of Boston, Mass., which distributes heated air throughout the building and forces it into the pits beneath the locomotives in large quantities. During the winter months the snow and ice are quickly melted from the running gear of the locomotives and the time for cleaning and repairing them is greatly reduced.

STEAM TURBINE PLANT IN KLONDIKE.—The Westinghouse companies have just received an order from the Canadian Klondike Mining Company for the equipment of a power house for the electrical operation of gold dredging boats on the Alaskan rivers. A 400-kilowatt turbo-generator will be driven by a 600-h.p. Westinghouse-Parsons steam turbine. On the dredge boats will be installed induction motors aggregating a total of about 500 h.p. and varying in size from 7½ to 100 h.p. The fact that the mining company is willing to install a plant of this nature far from the manufactory and possible repairs shows the confidence engineers place in this type of unit.

MORSE CHAIN.—The new plant at Ithaca of the Morse Chain Co., Trumansburg, N. Y., will consist of a machine shop, forge shop, hardening and tempering shop, wood shop, pattern storage, foundry and offices. The power plant will consist of Westinghouse single-acting compound engines direct connected to 80 kw. 125-volt direct-current generators from the World's Fair at St. Louis, supplied by Babcock and Wilcox boilers at 130-lb. pressure. The machine shop equipment will be modern in every respect, with individual and group drives from 110-volt motors. Work of completing the details is now progressing rapidly preparatory to commencing work of erection in the spring.

FARLOW DRAFT GEAR.—Mr. M. A. Garrett, vice president of the Farlow Draft Gear Company, directs attention to the fact that of the contingencies which usually lead to the failure of draft gears, 11 are enumerated for each end of the gear, the Farlow gear presents but one, viz: the possibility of broken couplers. This draft gear is put together without rivets or pockets. It has no followers of the usual type to bend and break. The springs are protected from breakage and from becoming solid. There are no lugs or check castings to break and this gear is held to be free from the danger of broken coupler pin chains. As the possibilities for breakage are the same for both ends of the car, it is obvious that if these claims are sustained in practice and the results of the remarkable test of this gear at Purdue University are borne out that the number of contingencies for breakage are greatly reduced.